Basin-Specific Feasibility Studies

Everglades Protection Area Tributary Basins

Evaluation of Alternatives for the ECP Basins

Submitted to

South Florida Water Management District

October 23, 2002
Contract No. C-E023
Project No. 29042

In Association With

October 23, 2002

Ms.Tracey Piccone, P.E.
Senior Environmental Engineer
Environmental Engineering Section
CERP/ECP Department
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

South Florida Water Management District
Basin-Specific Feasibility Studies
Everglades Protection Area Tributary Basins

Evaluation of Alternatives for the ECP Basins

Dear Ms. Piccone:

Burns & McDonnell, in association with Nova Consulting, Inc, is pleased to submit this Evaluation of Alternatives for the Basin-Specific Feasibility Studies, Everglades Construction Project Basins. This document comprises the Final submittal required under Subtask 4.2 of the Statement of Work (Appendix "C" to Contract C-E023). Also enclosed is a compact disk containing .pdf files of this document. The various data files and working spreadsheets developed during the course of these studies, previously provided to the District, remain current.

We gratefully acknowledge the District's contributions, as well of those of the various stakeholders in the ECP Basins, to the preparation of this Evaluation of Alternatives. Please feel free to contact me at 816-822-3099 or electronically (gmiller@burnsmcd.com) should you have any questions or desire additional information.

Sincerely,

Galen E. Miller, P.E.	James M. Kanter, P.E.	Stephanie C. Otis, Ph.D., E.I.
Associate Vice President	Project Manager	Project Engineer
Principal in Charge		

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
Basin-Specific Feasibility Studies
Everglades Protection Area Tributary Basins

EVALUATION OF ALTERNATIVES FOR THE ECP BASINS

2002

INDEX AND CERTIFICATION

Index

Certification

I hereby certify, as a Professional Engineer in the State of Florida, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the South Florida Water Management District or others without specific verification or adaptation by the Engineer. This certification is provided in accordance with the Florida Board of Professional Engineers' Rule on Certification under Chapter 21H-29.

____

Galen E. Miller, P.E.
Date: October 23, 2002
(Reproductions are not valid unless signed, dated and embossed with Engineer's seal)

EXECUTIVE SUMMARY

The long-term Everglades water quality objective is to implement the optimal combination of source controls, STAs, Advanced Treatment Technologies (ATTs), and/or regulatory programs to ensure that all waters discharged to the Everglades Protection Area (EPA) achieve water quality goals by December 31, 2006. Permit applications and integrated water quality plans are to be submitted to the Florida Department of Environmental Protection (FDEP) by December 31, 2003. To meet these objectives and time frames, the District is conducting basin-specific feasibility studies that will integrate information from research, regulation, and planning studies to provide information necessary to allow policy makers to determine the optimal combination of source controls and basin-scale treatment to meet the final water quality objectives.

The results of these studies are not intended to define the final arrangement, location and character of the final strategy for each basin. Rather, the purpose of the evaluation is to develop the information necessary for informed decision-making by the District's Board of Governors and the Florida Legislature relative to funding, final implementation schedule, rulemaking, and those other policy-level determinations necessary to permit the State of Florida and the South Florida Water Management District to proceed to fulfillment of their obligations under the federal Everglades Settlement Agreement (Case No. 88-1886-CIV-HOEVELER) and Florida's 1994 Everglades Forever Act (F.S. 373.4592).

The District has compiled basin-specific characteristics and developed alternative combinations of point source control, basin-level, and regional water quality treatment solutions for each of the ECP basins. Preliminary combinations of alternatives for the basins tributary to the various stormwater treatment areas constructed under the ECP have been disseminated by the District in the October 30, 2001 Final Draft of *Water Quality Improvement Strategies for the Everglades, Preliminary Alternative Combinations for the ECP Basins.* The alternatives finally adopted by the District for evaluation, considering both that Peer Review and input by other stakeholders, were considered in this report.

This document presents of the assessment of the technical, environmental, and economic performance criteria for the ECP Basin alternatives conducted by Burns & McDonnell Engineering Company, Inc., in association with Nova Consulting, Inc. The conduct of the Burns & McDonnell criteria assessment of the Alternative Combinations for the ECP Basins and preparation of this document was authorized by the District's Board of Governors through its approval on March 27, 2002 of Amendment 1 to Contract C-E023.

The assessment of alternatives under Task 4 of Contract C-E023 employ the most recent version (April 12, 2002) of the DMSTA (Dynamic Model for Stormwater Treatment Areas) analytical tool (Walker and Kadlec). These analyses are not meant to form final projections of treatment performance, but only to assess, in sufficient detail appropriate for feasibility level studies, the degree to which marked improvement from baseline conditions might be anticipated for informed decision-making by the District's Board of Governors and the Florida Legislature. **The estimated performance of various vegetative communities in the reduction of phosphorus as reflected in these analyses represents the best information presently available. However, there remains a significant degree of uncertainty in that performance. The analyses presented herein include an assessment of the sensitivity of the predicted performance to variations in all input parameters.**

These analyses employ South Florida Water Management Model (SFWMM) data, in the form of Excel files furnished by the District, for atmospheric and surface (and ground) water information with its associated phosphorus concentrations as inputs into the DMSTA model for the evaluation of treatment performance. Inputs into the DMSTA model also include hydraulic and seepage information specific to each STA. The evaluation of other technical and environmental criteria is assessed using best professional judgment on advanced technology information presented in the Standard Technology Standards of Comparison documents prepared for the District by previous consultants. The evaluation of economic criteria employ information disseminated by the District in the March 15, 2002 Draft of the *Final Evaluation Methodology for the Water Quality Improvement Strategies for the Everglades*, supplemented where necessary with additional info from recent contract experience on the ECP projects. **The opinions of probable capital costs and probable incremental operation and maintenance costs presented in this document are considered suitable for the development and evaluation of alternatives at the feasibility**

study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

Part 1 defines the parameters employed in the analysis for the various wetland types to be used in advanced treatment (e.g., SAV and PSTA) and for basins and reservoirs. The parameters used herein have not been finally established, and continue to be updated as additional performance data becomes available. **All estimates of treatment performance presented herein should not be taken as final determinations of true performance.**

As a part of this evaluation, the estimated STA inflows and outflows presented in the District's May 2001 *Baseline Data for the Basin-Specific Feasibility Studies* have been revisited. In some instances, certain adjustments have been made to estimated inflow volumes and total phosphorus (TP) loads. In each instance, the projected long-term mean outflow volumes and TP loads and concentrations have been determined through use of the DMSTA Model. The baseline performance of the various STAs of the Everglades Construction Project considered in this evaluation is summarized in Table ES-1.

Table ES-1. 50-Yr Estimates of Baseline Inflows and Outflows

Location	Estimated Average Annual Inflow			Estimated Average Annual Outflow		
	Volume (acre-feet)	TP Load (tonnes)	TP Conc. *(ppb)	Volume (acre-feet)	TP Load (tonnes)	TP Conc. **(ppb)
STA-1E	133,300	28.95	176	148,400	7.03	38/34
STA-1W	160,300	27.40	139	188,100	5.65	24/24
STA-2	212,400	26.17	103	202,100	7.74	31/32
STA-3/4	633,700	60.74	78	593,800	23.92	33/31
STA-5	144,600	31.80	179	138,400	7.77	46/35
STA-6	57,000	5.48	78	54,000	2.02	30/24
Total	**1,341,300**	**180.54**	**109**	**1,324,800**	**54.13**	**33***

* Flow-weighted Mean Concentration
** Flow-weighted Mean / Geometric Mean Concentrations

The preliminary combinations of alternatives disseminated by the District in the October 30, 2001 Final Draft of *Water Quality Improvement Strategies for the Everglades, Preliminary Alternative Combinations for the ECP Basins* was subsequently peer reviewed by Burns & McDonnell, as reported in the December 31, 2001 Final Draft *of Preliminary Alternative Combinations for the*

ECP Basins. The alternatives adopted by the District for evaluation, considering both that Peer Review and input by other stakeholders, have been modified throughout Task 4. A summary of those alternatives, including the comparative estimates of their relative performance in reducing total phosphorus loads discharged to the EPA, is presented in Table ES-2.

In particular, there exists a fairly broad range in the estimated performance of Submerged Aquatic Vegetation (SAV). The evaluation of alternatives employing that vegetation is based primarily on use of the SAV_C4 treatment parameters defined in the DMSTA model. Those parameters are taken from the best two years' performance in Cell 4 of STA-1W. However, that performance has yet to be replicated at large scale, suggesting the need for additional effort to more fully understand how that performance can be reliably established in the various stormwater treatment areas. Accordingly, the analyses presented herein include evaluation of the potential impact on treatment performance should it eventually prove impracticable to replicate the performance of Cell 4. Those evaluations employ the Nonemergent Wetland Systems (NEWS) treatment performance parameters in the DMSTA model. In general, should the SAV community eventually perform as NEWS in lieu of SAV_C4, the analyses suggest an increase of 1-5 ppb in the long-term geometric mean outflow concentrations, and from 7-10 ppb in the long-term flow-weighted mean outflow concentrations. A continued program focused on development of processes to be employed toward replication of the Cell 4 performance is considered a central need of the overall water quality improvement strategies in the ECP basins.

There also exists a range of estimated performance depending on the level of phosphorus reduction due to BMP's employed in the analyses. The BMP reduction levels employed for major inflow sources varied, but were typically assigned at 50% for the EAA basins. Varying the BMP reduction levels from 25% to 75% in the baseline analyses resulted in an increase/decrease of 7-12 ppb in the STA outflows. Following completion of possible improvements to the STAs, varying the BMP reduction levels from 25%-75% resulted in an estimated increase/decrease of 0-5 ppb in STA outflows. Though the effect of BMPs levels employed is markedly less for STAs enhanced as described herein, other benefits such as reduced maintenance costs associated with removal of SAV accruals, which is not apparent in this study, suggest that the BMP program is still critical to the success of attaining the final phosphorus reduction goal.

Table ES-2. Summary of Alternatives Considered

Location	Alternative	Year	Description	Remarks	50-yr Est. Average Annual Inflow			50-yr Est. Average Annual Outflow			Long-Term TP Conc.	
		Optimized Design			Volume (acre-feet)	TP Load (tonnes)	TP Conc. (ppb)	Volume (acre-feet)	TP Load (tonnes)	TP Conc. (ppb)	FWM (ppb)#	GM (ppb)#
STA-1E	Baseline	2006	Current design, considered as emergent macrophyte STA	TP Reduction in Distribution Cells considered (typ all alts.)	133,300	28.95	176	148,400	7.03	38	38	34
	1	2006	Optimized design with SAV in south cells	L-8 CERP Reservoir not required	133,300	28.95	176	143,500	2.62	15	15/24	10*/11
	2	2006	Optimized design with SAV in south cells & ACME Basin B flows	L-8 CERP Reservoir not required	164,800	32.61	160	175,200	3.34	15	15/24	10*/11
STA-1W	Baseline	2006	Current design, considered as emergent macrophyte STA	Existing SAV in Cells 4 and 5B (typ all alts.)	160,300	27.4	139	188,100	5.65	24	24/30	24/26
	1	2006	Optimized design with SAV in south cells	Cell 3 converted to SAV	160,300	27.4	139	188,100	4.35	19	19/27	14/16
	2	2006	Further Optimized Design with SAV in more cells	Alt 1 plus Parts of Cells 1 & 2 converted to SAV	160,300	27.4	139	183,300	2.99	14	14*/22	10*/13
STA-2	Baseline	2006	Current design, considered as emergent macrophyte STA	Existing SAV in Cell 3 (typ all alts.)	212,400	26.17	103	202,100	7.74	31	31/34	32/34
	1	2006	Optimized design with SAV in south cells	60% of downstream Cells 1 & 2 converted to SAV	212,400	26.17	103	201,500	3.73	15	15/24	10*/13
STA-3/4	Baseline	2006	Current design, considered as emergent macrophyte STA	Future flows routed through Compartments A1, A2 & A3 (typ all alts.)	633,700	60.74	78	593,800	23.92	33	33	31
	1	2014	Optimized design with SAV in south cells	Cells 1B, 2B & downstream Cell 3 converted to SAV	633,700	60.74	78	594,200	13.03	18	14*/21	10/15
	2	2006	Optimized design with SAV in south cells	Same as Alt 1	633,700	60.74	78	621,200	10.98	14	14*/21	10/15
STA-5	Baseline	2006	Current design, considered as emergent macrophyte STA	Existing SAV in Cell 1B (typ all alts.)	144,600	31.8	179	138,400	7.77	46	46/50	36/38
	1	2014	Optimized design with SAV in east cells	Cell 2B converted to SAV	144,600	31.8	179	138,000	3.91	23	19/28	12/14
	2	2006	Optimized design with SAV in east cells	Same as Alt 1	144,600	31.8	179	137,900	3.29	19	19/28	12/14
	3	2014	Further Optimized design with SAV in east cells w/ all C-139 flows	Alt 1 plus new Cells 1AE & 2AE converted to SAV, and 730 acres east of L-2 added, and All C-139 flows directed to STA-5	146,900	32.43	175	141,100	3.29	19	15/24	10*/12
	4	2014	Optimized design with SAV in east cells & Integration w/Reservoir	Future flows routed through Compartment C	144,100	17.39	98	135,900	3.12	19	14*/21	10*/12
STA-6	Baseline	2006	Proposed design#, considered as emergent macrophyte STA	Includes proposed Section 2 configuration, and future flows routed through Compartment C (typ all alts.)	57,000	5.48	78	54,000	2.02	30	31	25
	1	2014	Optimized design with SAV in east cells	Cell 4 and downstream Cell 5 converted to SAV	57,000	5.48	78	54,000	1.2	18	17/24	10/14
	2	2006	Optimized design with SAV in east cells	Same as Alt 1	57,000	5.48	78	54,000	1.13	17	17/24	10/14
	3	2014	Further Optimized design with SAV in east cells & Resized Section 2	Alt 1 plus no C-139 flows and Section 2 area reduced 20%	54,700	4.85	72	51,800	1.03	16	15/22	10*/12
	4	2014	Optimized design with SAV in east cells & Integration w/Reservoir	Same as Alt 1	56,000	5.83	84	53,100	1.02	16	14*/20	10/13
Integrated STAs	1	2014	Optimized design of STAs with Integrated Reservoirs	Similar to STA-2 Alt 1, STA-3/4 & 5,6 Alt 2 with EAA Reservoirs treated more as an integrated whole	1,238,554	149.89	98	968,000	16.72	14*	14*	-

*Increased from computed value to reflect lower limit of calibration range
SAV-C4 / NEWS Vegetation Community

In general, the range of estimated performance is affected by many elements within STA design, operations, and maintenance, of which 25 different factors were examined. An inflow variation of 25% was employed for all factors, yet none showed significant outflow variation (i.e. all differences were less than 25%). However, the outflow phosphorus concentrations of the STAs were most sensitive to "Inflow Fraction" (e.g., TP load applied to a given area), which is consistent with the theory that regardless of vegetation type, the size of area used directly affects the effectiveness of water treatment.

It should be noted that implementation of the Comprehensive Everglades Restoration Plan (CERP) can be expected to markedly affect the volume and timing of inflows (including phosphorus loads) to the stormwater treatment areas. This is particularly true of STA-2, STA-3/4, STA-5, and STA-6, each of which may be impacted by the EAA Storage Reservoirs projects(s). The specific manner in which the EAA Storage Reservoir project is implemented can directly impact the future treatment performance of those four stormwater treatment areas.

Based on the results of preliminary analyses conducted during the course of these Basin-Specific Feasibility Studies, it may be possible to incorporate beneficial water quality improvement strategies during implementation of the EAA Storage Reservoir Project without either:

- Sacrificing or impairing the hydrologic function of the reservoirs, or
- Significantly impacting the capital or operations and maintenance cost of the reservoirs.

Certain concepts developed under those preliminary analyses will be forwarded to the EAA Storage Reservoirs Project Delivery Team for consideration as it develops the Project Implementation Report for the reservoirs. An example case of possible alternative combinations for the ECP is shown in Table ES-3, which is discussed in further detail in Part 6 of this report. This is but one example of possible combinations that may result in improved overall treatment performance, which would provide additional assurance of the ability of the various STAs in the ECP basins to meet the final water quality goals for discharges to the Everglades Protection Area.

Table ES-3. Example Regional Combination of ECP Basin Alternatives

Basin (STA)	Alter-native	Baseline Conditions Average Annual Discharge			Alternative Combination Average Annual Discharge		
		Volume (ac-ft)	TP Load (tonnes)	FWM Conc. (ppb)	Volume (ac-ft)	TP Load (tonnes)	FWM Conc. (ppb)
2	1	202,100	7.74	31	194,800	3.48	14
3/4	2	593,800	23.96	33	590,300	10.24	14
5	2	138,400	7.77	46	124,700	2.30	15
6	2	54,000	2.02	30	64,100	1.13	14
	Total	988,300	41.49	34	973,900	17.15	14

Table of Contents

List of Tables

List of Figures

1.0 GENERAL

1.1 Introduction

Florida's 1994 Everglades Forever Act (EFA) establishes both interim and long-term water quality goals to achieve restoration and protection of the Everglades Protection Area (EPA). The South Florida Water Management District (District), in partnership with other agencies and private landowners, is aggressively and successfully achieving these interim milestones. The District has constructed four Stormwater Treatment Areas (STAs) totaling almost 20,000 acres, and has just begun construction of the largest one, STA-3/4, with more than 17,000 acres. In addition, the Corps of Engineers is constructing the 5,500-acre STA-1 East. The STAs, coupled with on-farm Best Management Practices (BMPs), are designed to reduce the total phosphorus (TP) concentration in runoff from approximately 150 ppb to an interim target of 50 ppb. EAA landowners have implemented BMPs that have reduced phosphorus loads by more than 50% over the last six years. Concurrent with implementation of the Everglades Construction Project (ECP), the District is implementing the Everglades Stormwater Program (ESP) to address the water quality issues associated with discharges from the remaining non-ECP Everglades tributary basins. Also concurrent with these activities, the District and other groups are conducting water quality research and ecosystem-wide planning, and implementing regulatory programs to ensure a sound scientific foundation for decision-making.

The long-term Everglades water quality objective is to implement the optimal combination of source controls, STAs, Advanced Treatment Technologies (ATTs), and/or regulatory programs to ensure that all waters discharged to the Everglades Protection Area (EPA) achieve water quality goals by December 31, 2006. Permit applications and integrated water quality plans are to be submitted to the Florida Department of Environmental Protection (FDEP) by December 31, 2003. To meet these objectives and time frames, the District is conducting basin-specific feasibility studies that will integrate information from research, regulation, and planning studies to provide information necessary to allow policy makers to determine the optimal combination of source controls and basin-scale treatment to meet the final water quality objectives.

The goal of the basin-specific feasibility studies is to integrate research, planning and other available information into viable water quality improvement strategies to ensure that all waters discharged into the EPA achieve water quality goals. Of the sixteen basins that presently discharge into the EPA, the basin-specific feasibility studies will identify and evaluate alternative combinations for source control and basin-scale treatment for thirteen hydrologic basins – seven basins covered by the Everglades Construction Project (ECP) and six basins covered by the Everglades Stormwater Program (ESP). Two ESP basins (C-111 Basin and Boynton Farms Basin) will be addressed through other District and Federal programs, as will the L-8 Basin, which is not intended to discharge to the EPA long-term.

Basin-specific feasibility studies for the seven basins covered by the ECP are addressed herein, and have been prepared by Burns & McDonnell under the District's Contract No. C-E023. Basin-specific feasibility studies for the six basins covered by the ESP are being prepared by Brown & Caldwell under the District's Contract No. C-E024.

As the ECP basins all discharge to stormwater treatment areas (STAs), the evaluations and feasibility studies prepared under Contract C-E023 will be STA-specific. Feasibility studies have been prepared for each of the STAs (i.e. STA-1E, STA-1W, STA2, STA-3/4, STA-5, and STA-6). An overview of the Everglades Construction Project indicating the general location and extent of those various STAs is presented in Figure 1.1.

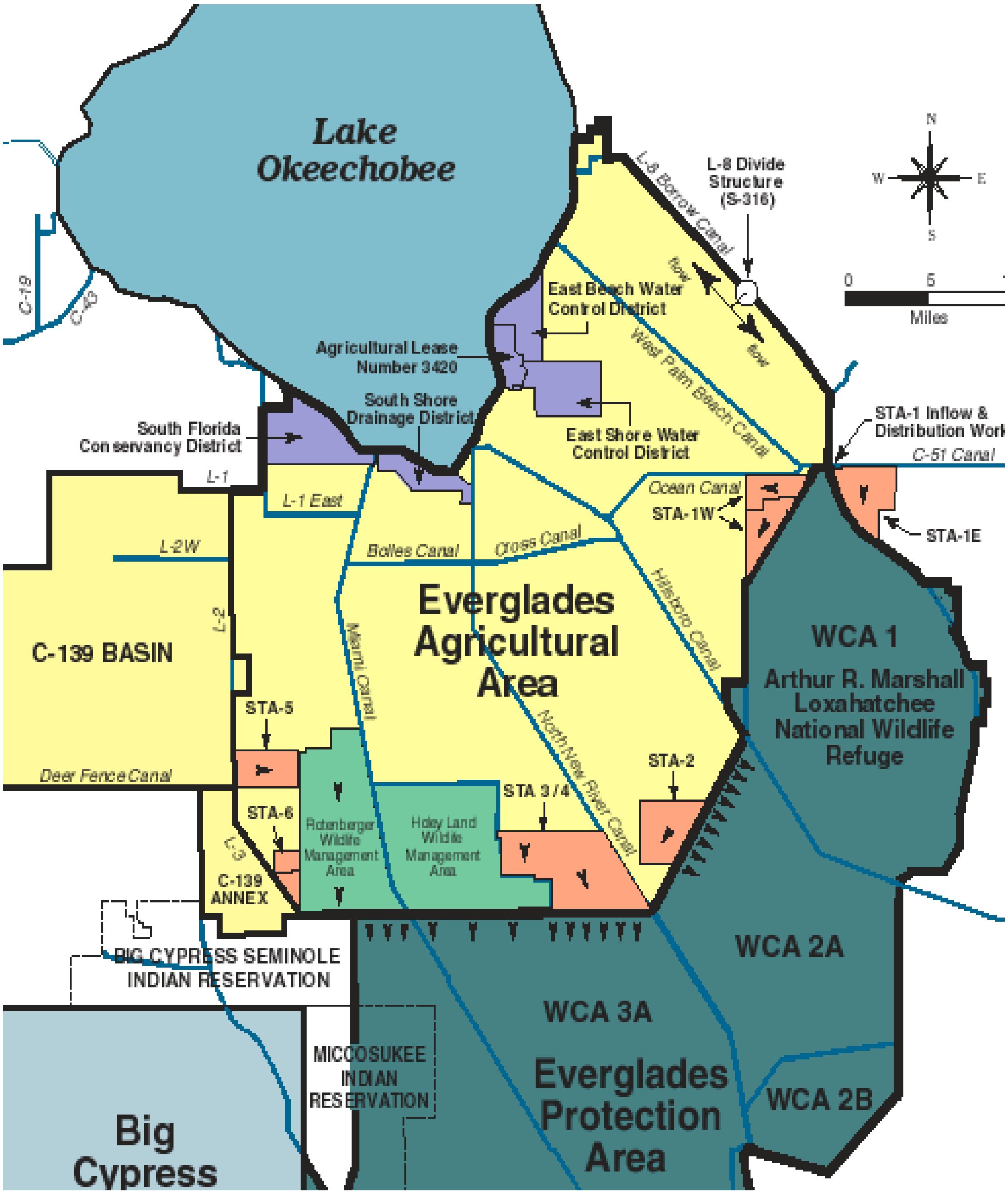


Figure 1.1 Overview of Everglades Construction Project

Burns & McDonnell SINCE 1898
NOVA CONSULTING, INC.

The results of these studies are not intended to define the final arrangement, location and character of the final strategy for each basin. Rather, the purpose of the evaluation is to develop the information necessary for informed decision-making by the District's Board of Governors and the Florida Legislature relative to funding, final implementation schedule, rulemaking, and those other policy-level determinations necessary to permit the State of Florida and the South Florida Water Management District to proceed to fulfillment of their obligations under the federal Everglades Settlement Agreement (Case No. 88-1886-CIV-HOEVELER) and Florida's 1994 Everglades Forever Act (F.S. 373.4592).

The District has compiled basin-specific characteristics and developed preliminary alternative combination of point source control, basin-level, and regional water quality treatment solutions for each of the ECP basins. In preparing these alternative combinations, the District has used the baseline set of flow and water quality data, BMP research, STA optimization research, advanced treatment technologies research, and available data from other ongoing research activities. The District has considered the Comprehensive Everglades Restoration Plan (CERP, formerly known as the Restudy), Critical Restoration projects, and basin-specific water quality programs in formulating alternative combinations of water quality solutions. The District also utilized external review teams to assist in preparing the preliminary alternative combinations of water quality solutions.

The preliminary combinations of alternatives for the basins tributary to the various stormwater treatment areas constructed under the ECP were disseminated by the District in the October 30, 2001 Final Draft of *Water Quality Improvement Strategies for the Everglades, Preliminary Alternative Combinations for the ECP Basins*. Burns & McDonnell subsequently conducted a peer review of the proposed alternatives for the ECP basins, as reported in the December 31, 2001 Final Draft *of Preliminary Alternative Combinations for the ECP Basins*. The alternatives adopted by the District for evaluation, considering both that Peer Review and input by other stakeholders, are shown in Table 1.1.

Table 1.1: Summary of ECP Basin Alternatives

Basin/STA	Alt.	Source Controls	CERP Project	Regional Treatment	Regional treatment completion	Flow and Load Phases	Sequencing over 50 years	TP concentrations and flows
STA-1E	Baseline	25%	N/A	STA-1E (existing)	2003	1 phase 2006-2056	just STA 1E between 2006 and 2056 with no retrofits	Baseline
	1	0-25%	2010-2020	STA-1E (retrofit in 2020)	2020	3 phases: 2006-2010 2010-2020 2021-2056	STA-1E with no improvements through 2020; then CERP flows and loads through STA-1E, retrofitted to achieve lowest sustainable biological TP	modified CERP flows
	2	0-25%	2010-2020	Optimize STA-1E by 2006	2006	3 phases: 2006-2010 2010-2020 2021-2056	Optimized STA-1E by 2006 through 2010/20; then CERP flows and loads through STA-1E	modified CERP flows
STA-1W	Baseline	~50%	N/A	STA-1W (existing)	2006	1 phase 2006-2056	just STA 1W between 2006 and 2056 with no retrofits	Baseline
	1	25-75%	2010, 2011, 2020	STA-1W (optimized if needed in 2020)	2020	3 phases: 2006-2010 2010-2020 2021-2056	STA-1W with no improvements through 2020; then reduction in C-51W runoff through STA-1W due to CERP, optimized in 2020 if needed to achieve lowest sustainable biological TP	
	2	25-75%	2010, 2011, 2020	Optimize STA-1W by 2006	2006	3 phases: 2006-2010 2010-2020 2021-2056	Optimized STA-1W by 2006 through 2010 and 2020; then reduction in flows from C-51W due to CERP	
Combined STA-1E & STA-1W	3*	0-25%	2010-2020	Expand STA-1E and STA-1W by 2006	2006	3 phases: 2006-2010 2010-2020 2021-2056	Expand STA-1E and 1W if needed to reduce TP to LSC; then model influce of modified flows due to CERP	same as baseline
	4	0-25%	2010-2020	Expand STA-1E and STA-1W to treat Acme Basin B by 2006	2006	3 phases: 2006-2010 2010-2020 2021-2056	Incremental expansion of 1E/1W by 2006 to treat Acme B; then model influence of CERP flows	combined C-51W runoff with Acme runoff
	5*	0-25%	2010, 2011, 2020	Optimize STA-1E by 2006 and Divert/Treat Acme Basin B in Rock Pits by 2011	2006	3 phases: 2006-2010 2011-2020 2021-2056	No influence on STA-1W; optimize STA-1E by 2006; then model influence of CERP projects, including diversion of Acme B by 2011; size biological treatment adjacent of L-8 rock pit for Acme basin B runoff by 2011; from 2006-2011 Acme Basin B runoff continues to EPA; from 2011-2056, Acme runoff does not go to EPA	combined C-51W runoff with Acme runoff
STA-2	Baseline	~50%	N/A	STA-2 (existing)	2006	1 phase 2006-2056	just STA 2 between 2006 and 2056 with no retrofits	Baseline
	1	**25-75%**	**2014**	**STA-2 (optimize by 2009)**	**2009**	**2 phases 2006-2009 2009-2056**	**Route STA-2 inflows through the eastern reservoir prior to going to STA-2; in addition to other reservoir inflows; if reservoir full, then flow goes to STA-2**	**Problem - no SFWMM results**
	2	25-75%	2014	Optimize STA-2 by 2006	2006	2 phases 2006-2014 2014-2056	Optimized STA-2 by 2006; then model influence of CERP	baseline between 2006 and 2014; CERP after 2014
	3*	25-75%	2014	Chemical treatment facility within footprint of STA-2 by 2006	2006	2 phases 2006-2014 2014-2056	Construct chemical treatment facility within STA-2 footprint by 2006; then model influence of CERP	baseline between 2006 and 2014; CERP after 2014

*Incremental Alternatives: would be examined only if needed--i.e. LSC not met in preceding alternative(s)

Continued on next page

Table 1.1(cont): Summary of ECP Basin Alternatives

Basin/STA	Alt.	Source Controls	CERP Project	Regional Treatment	Regional treatment completion	Flow and Load Phases	Sequencing over 50 years	TP concentrations and flows
STA-3/4	Baseline	~50%	N/A	STA-3/4 (existing)	2006	1 phase 2006-2056	just STA-3/4 between 2006 and 2056 with no retrofits	Baseline
	1	25-75%	2014	STA-3/4 (optimize by 2014)	2014	2 phases 2006-2014 2014-2056	existing STA-3/4 through 2014; then optimize STA-3/4 based on flows/loads from CERP reservoir	baseline between 2006 and 2014; CERP after 2014
	2	25-75%	2014	Optimize STA-3/4 by 2006	2006	2 phases 2006-2014 2014-2056	Optimize STA-3/4 by 2006 then model influence of EAA Reservoir flows and loads	baseline between 2006 and 2014; CERP after 2014
	3*	25-75%	2014	Expand STA-3/4 by 2006	2006	2 phases 2006-2014 2014-2056	Expand STA-3/4, if needed, to achieve LSC with emergent/SAV	baseline between 2006 and 2014; CERP after 2014
	4*	25-75%	2014	Expand STA-3/4 by 2006	2006	2 phases 2006-2014 2014-2056	Expand STA-3/4, if needed, to achieve LSC with emergent/SAV/PSTA	baseline between 2006 and 2014; CERP after 2014
STA-5 and STA-6	Baseline	25% for EAA; 0% for C-139	N/A	STA-5 and STA-6, Sections 1 and 2	2006	1 phase 2006-2056	just STA-5 and STA-6 Sections 1 and 2 between 2006 and 2056 with no retrofits	Baseline
	1	0-25% for C-139 Basin	2014	Optimize, if needed, STA-5 and STA-6, Sections 1 and 2, by 2014	2014	2 phases 2006-2014 2014-2056	Optimize STA-5 and STA-6, if needed by 2014; baseline flows through 2014 then model influence of modified inflows due to EAA Reservoir	Baseline through 2014, then modified flows due to CERP projects
	2	0-25% for C-139 Basin	2014	Optimize treatment in STA-5 and STA-6 by 2006	2006	2 phases 2006-2014 2014-2056	Optimize STA-5 and STA-6 by 2006; baseline flows through 2014 then model influence of modified inflows due to EAA Reservoir	Baseline through 2014, then modified flows due to CERP projects
	3*	0-25% for C-139 Basin	2014	Expand STA-5 to the west, optimize STA-5 and STA-6 Section 1, and size STA-6 Section 2 as needed	2014	2 phases 2006-2014 2014-2056	Expand STA-5 by 300 acres, then size STA-6 Section 2 as needed to lower inflows to LSC with emergent/SAV	Baseline through 2014, then modified flows due to CERP projects
	4*	**0-25% for C-139 Basin**	**2014**	**STA-5 and STA-6, Sections 1 and 2**	**2014**	**2 phases 2006-2014 2014-2056**	**Modified Alternative 1 in the runoff from C-139 and C-139 Annex goes first to the western reservoir and then to the STAs; optimize STA-5 and STA-6, if needed by 2014; baseline flows through 2014 then model influence of modified inflows due to EAA Reservoir**	**Problem - no SFWMM results; possibly use spreadsheet model (DMSTA) to route daily flows through reservoir**
Integrated STAs	1	25%-75% for EAA; 0-25% for other basins	2014	All STAs	2014	**2 phases 2006-2014 2014-2056**	need to flesh out	

*Incremental Alternatives: would be examined only if needed--i.e. LSC not met in preceding alternative(s)

Throughout Task 4, the alternatives as shown in Table 1.1 were modified or dropped due to the following reasons:

1. The lowest sustainable concentration (LSC) was achieved without the need for additional modifications:
   - STA-1E achieved LSC with both the existing baseline and Acme Basin B flows by converting its downstream cells (i.e. Cells 2, 4N, 4S and 6) to SAV without requiring additional treatment by either STA-1W or the L-8 Rock Pits. Thus, combined STA-1E/1W Alternatives 3 and 5 were dropped from further consideration.
   - STA-2 achieved LSC through converting its downstream area (Cells 1B, 2B, and 3B) into SAV cells without expansion, enlarging the SAV cells, nor requiring additional treatment (i.e. CTSS). Thus, Alternative 3, the CTSS treatment was dropped from further consideration.
   - STA-3/4 achieved LSC through converting its downstream cells (i.e. Cells 1B and 2B), and downstream area of Cell 3 into SAV without requiring expansion. Thus, Alternatives 3 and 4 were dropped from further consideration.
2. The routing of inflow through EAA Storage Reservoirs typically resulted in providing significant computed benefit other than as noted below:
   - Routing STA-2 inflows through Compartment B without significantly altering reservoir operation provided minimal phosphorus reduction benefit; thus Alternative 1 was dropped from further consideration. ("Alternative 2" was subsequently renamed "Alternative 1.")
3. The Source Controls (i.e. BMP levels) were changed to more accurately reflect actual conditions:
   - STA-1E baseline concentration included a BMP reduction of 0% (not 25%) for C-51, and 50% (not 25%) for EAA inflows per May 7, 2002 District memo.
   - STA-5 baseline included a BMP reduction of 0% for C-139, and 50% (not 25%) for USSC inflows (change made consistent with EAA inflow concentrations for all STAs).
4. The Regional Treatment Completion Date was changed consistent with other changes:

- The baseline for STA-1E is 2006 as is with all other STA baselines; the timeline for the analysis of this study begins in 2007.
- The Regional Treatment Completion Date for Alternative 1 of both STA-1W and STA-1E is 2006 because no flow is routed through any CERP element due to achievement of LSC in STA-1E.

5. The flow and load phases were changed to reflect actual CERP completion dates or availability of data sufficient for analyses:
   - The number of phases went from 3 to 1 due to lack of insufficient post-CERP data (per May 8, 2002 District Memo) for STA-1W and STA-1E after year 2014, and due to no need to route inflows from either STA through CERP element (i.e. L-8 Rock Pits).
   - The number of phases went from 1 to 2 (i.e. 2006-14 and 2015-56) for STA-2, STA-3/4, and STA-5,6 baseline cases due to impact of different flow and load conditions of the CERP elements (i.e. Baseline Future Condition).
6. Other issues:
   - The inflows for STA-5,6 Alternative 4 were obtained from routing inflows through Compartment C which was estimated by use of W. W. Walker's methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, as described in Section 5.7.1.
   - The CERP Project dates were modified, consistent with other changes. Any project which utilized future inflow data affected by CERP operations, has a CERP date set at 2014; all others are stated not applicable, or "N/A."

The alternatives finally adopted by the District for evaluation, as modified throughout the conduct of Task 4, are shown in Table 1.2.

Table 1.2: Final Summary of ECP Basin Alternatives

Basin/STA	Alt.	Source Controls	CERP Project	Regional Treatment	Regional treatment completion	Flow and Load Phases	Sequencing over 50 years	TP concentrations and flows
STA-1E	Baseline	0% for C51, 50% for EAA	N/A	STA-1E (existing)	2006	1 phase 2006-2056	just STA 1E between 2006 and 2056 with no retrofits	Baseline
	1*	0-25% for C51, 25-75% for EAA	N/A	Optimize STA-1E by 2006	2006	1 phase 2006-2056	STA-1E retrofit with emer/SAV to achieve LSC	Baseline
	2*	0-25% for C51, 25-75% for EAA, 0-50% for Acme	N/A	Optimize STA-1E with ACME Basin B Flows by 2006	2006	1 phase 2006-2056	STA-1E & Acme Basins B flows (BMP 25%), retrofit with emer/SAV to achieve LSC	modified CERP flows
STA-1W	Baseline	50% for S-5A	N/A	STA-1W (existing)	2006	1 phase 2006-2056	just STA 1W between 2006 and 2056 with no retrofits	Baseline
	1	25-75%	N/A	Optimize STA-1W by 2006	2006	1 phase 2006-2056	STA 1W retrofit with emer/SAV between 2006 and 2056	Baseline
	2*	25-75%	N/A	Further Optimize STA-1W by 2006 to achieve LSC	2006	1 phase 2006-2056	STA 1W between 2006 and 2056 with additional retrofits to achieve LSC	Baseline
STA-2	Baseline	50% for Hills/WPB Canal	N/A	STA-2 (existing)	2006	2 phases 2006-2014 2014-2056	just STA 2 between 2006 and 2056 with no retrofits	baseline between 2006 and 2014; CERP after 2014
	1*	25-75%	2014	Optimize STA-2 by 2006	2006	2 phases 2006-2014 2014-2056	STA-2 retrofit with emer/SAV by 2006; then model influence of future flows due to EAA Reservoir flows and loads	baseline between 2006 and 2014; CERP after 2014
STA-3/4	Baseline	50% for S-7,8 Basins	N/A	STA-3/4 (existing)	2006	2 phases 2006-2014 2014-2056	just STA-3/4 between 2006 and 2056 with no retrofits	baseline between 2006 and 2014; CERP after 2014
	1*	25-75%	2014	STA-3/4 (optimize by 2014)	2014	2 phases 2006-2014 2014-2056	existing STA-3/4 through 2014; then STA-3/4 retrofit with emer/SAV based on flows/loads from CERP reservoir	baseline between 2006 and 2014; CERP after 2014
	2*	25-75%	2014	Optimize STA-3/4 by 2006	2006	2 phases 2006-2014 2014-2056	STA-3/4 retrofit with emer/SAV by 2006 then model influence of EAA Reservoir flows and loads	baseline between 2006 and 2014; CERP after 2014

*Alternatives for which LSC was met, thus no subsequent alternatives were investigated
Continued on next page

Table 1.2(cont): Final Summary of ECP Basin Alternatives

Basin/STA	Alt.	Source Controls	CERP Project	Regional Treatment	Regional treatment completion	Flow and Load Phases	Sequencing over 50 years	TP concentrations and flows
STA-5 and STA-6	Baseline	50% for USSC; 0% for C-139	N/A	existing STA-5 and STA-6 Section 1 and proposed STA-6 Section 2	2006	2 phases 2006-2014 2014-2056	just STA-5 and STA-6 Sections 1 and 2 between 2006 and 2056 with no retrofits	baseline between 2006 and 2014; CERP after 2014
	1	0-25% for C-139, 25-75% for USSC	2014	Optimize STA-5 and STA-6, Sections 1 and 2, by 2014	2014	2 phases 2006-2014 2014-2056	STA-5 and STA-6 retrofit with emer/SAV by 2014; baseline flows through 2014 then model influence of modified inflows due to EAA Reservoir	baseline between 2006 and 2014; CERP after 2014
	2	0-25% for C-139, 25-75% for USSC	2014	Optimize treatment in STA-5 and STA-6 by 2006	2006	2 phases 2006-2014 2014-2056	STA-5 and STA-6 retrofit with emer/SAV by 2006; baseline flows through 2014 then model influence of modified inflows due to EAA Reservoir	baseline between 2006 and 2014; CERP after 2014
	3*	0-25% for C-139, 25-75% for USSC	2014	Expand STA-5 to the west, optimize STA-5 & STA-6 Section 1, and re-size STA-6 Section 2	2014	2 phases 2006-2014 2014-2056	Expand STA-5 by 730 acres, then re-size STA-6 Section 2 to lower inflows to LSC with emer/SAV retrofit	baseline between 2006 and 2014; all C-139 flows to STA-5; CERP after 2014
	4*	0-25% for C-139, 25-75% for USSC	2014	Optimize STA-5 and STA-6, Sections 1 and 2, by 2014	2014	2 phases 2006-2014 2014-2056	Modified Alternative 1 in the runoff from C-139 and C-139 Annex goes first to the western reservoir and then to the STAs; STA-5 and STA-6 retrofit with emer/SAV by 2014	baseline between 2006 and 2014; CERP after 2014
Integrated STAs	1*	25%-75% for EAA; 0-25% for other basins	2014	Optimize STAs by 2014	2014	2 phases 2006-2014 2014-2056	Optimize STAs by 2006; route all waters through EAA Reservoirs by 2014	baseline between 2006 and 2014; CERP after 2014

*Alternatives for which LSC was met, thus no subsequent alternatives were investigated

Burns & McDonnell SINCE 1898

NOVA CONSULTING, INC.

1.1.1 Authorization

The conduct of the Burns & McDonnell Criteria Assessment of the District selected *ECP Basin Alternatives* and preparation of this document was authorized by the District's Board of Governors through its approval on March 27, 2002 of Amendment 1 to Contract C-E023. This document comprises the deliverable required under the updated version Task 4 as it is defined in Exhibit "C" *Scope of Services* attached to that contract.

1.2. Evaluation Methodology

The overall goals of Everglades restoration are to improve water quality; improve the quantity, distribution, and timing of water; and to control the spread of exotic species. From this, the Evaluation Methodology as described in *Evaluation Methodology for the Water Quality Improvement Strategies for the Everglades* disseminated by the District on March 15, 2002 was developed to fulfill several requirements, including the following:

- 1994 Everglades Forever Act (EFA)
- 2000 Water Resources Development Act (WRDA)
- 1992 Federal Everglades Consent Decree
- Federal and State statutes relating to implementation of the Comprehensive Everglades Restoration Program (CERP)
- Federal Clean Water Act

Of the above, the 1994 EFA (ss. 373.4592, Florida Statutes) provides the fundamental guidance on the criteria considered in evaluating the alternative combination of water quality improvement strategies.

2. The Legislature recognizes that technological advances may occur during the construction of the Everglades Construction Project. If superior technology becomes available in the future which can be implemented to more effectively meet the intent and purposes of this section, the District is authorized to pursue that alternative through permit modification to the department. The department may issue or modify a permit provided *that the alternative is demonstrated to be superior at achieving the restoration goals of the Everglades Construction Project considering:*

a. Levels of load reduction;
b. Levels of discharge concentration reduction;
c. Water quantity, distribution, and timing for the Everglades Protection Area;
d. Compliance with water quality standards;
e. Compatibility of treated water with the balance in natural populations of aquatic flora or fauna in the Everglades Protection Area;
f. Cost-effectiveness; and
g. The schedule for implementation.

In addition, as part of the Supplemental Technology Standard of Comparison (STSOC), evaluation criteria related to uncertainty, flexibility, management and compatibility were included (PEER Consultants, P.C./Brown and Caldwell, 1998).

The performance of the various Everglades Construction Project (ECP) stormwater treatment areas (and alternative improvement strategies) in meeting state water quality standards is expected to be influenced by:

- CERP projects which will affect the quantity, timing, and quality of waters delivered to the STAs.
- Advanced Technology Treatment (ATT): SAV (Submerged Aquatic Vegetation), PSTA (Periphyton Stormwater Treatment Areas), and CTSS (Chemical Treatment-Solids Separation); the alternative water quality improvement strategies rely in varying degree on the performance of the ATT for improve performance.

Table 1.3 is excerpted from the District's October 30, 2001 *Preliminary Alternative Combinations for the ECP Basins*, and defines those CERP projects which could influence the assessment of the alternatives' criteria. A general discussion of the influence of each ATT on the criteria assessment is described in Section 1.4.

Additional descriptive information on the CERP projects and ATT Technology is contained in the CERP websites http://www.evergladesplan.org/pm/projects and http://glacier.sfwmd.gov:80/org/erd/ecp/etweb/main_template/ethome.html.

Table 1.3 CERP Projects That May Influence Flows and Loads in the ECP Basins

CERP Project	Completion Date	STA-1E	STA-1W	STA-2	STA-3/4	STA-5	STA-6
ACME Basin "B" (A6.3.3.6)	4/25/07	✓	✓				
Rotenberger WMA Operations (EE5)	5/3/06				✓	✓	✓
Holey Land WMA Operations (DD)*	3/26/08				✓	✓	
Pump Station G-404 Modification (II3)	9/24/08				✓		✓
EAA Reservoir Ph. I (G6)	**9/16/09**			✓	✓	✓	✓
Decompartmentalization of WCA-3 (QQ6)*	10/4/10			✓	✓		✓
L-8 Basin (K Ph 1)	3/18/11	✓	✓				
C-51 & Southern L-8 Reservoir (GGG6)	3/14/14	✓	✓				
L-8 Basin ASR (K Ph 2)	10/18/18	✓	✓				
EAA Storage Reservoirs Ph. 2	9/17/14			✓	✓	✓	✓
C-51 Regional ASR (LL)	10/15/20	✓	✓				
Everglades Rain Driven Operations (H6)*	?			✓	✓		✓

Notes:
(1) CERP Projects in **Bold** were included in the initial project authorization in WRDA 2000.
(2) Completion dates taken from 7/27/2001 Update to CERP Master Implementation Schedule
(3) Projects listed with an asterisk (*) are not expected to influence the flows and phosphorus loads discharged from the ECP basins.

1.3 Evaluation Criteria

The criteria employed in this evaluation cover the general categories of Technical Performance, Environmental Factors, and Economic Considerations. Table 1.4 lists all the criteria and their applicable units (or ranges).

For Technical Performance criteria #1-2 the values were generated using the most recent (April 12, 2002) version of the DMSTA (Dynamic Model for Stormwater Treatment Areas) analytical tool (Walker and Kadlec). Analyses leading to the values prescribed are discussed in detail in the succeeding sections of this report. The values obtained for Technical Performance criteria #3-7 and Environmental criterion #1 are from the Supplemental Technology Standard of Comparison documents, and all other criteria values obtained for each ECP alternative are described in Sections 2-6 of this report. The 19 non-phosphorus parameters listed for the environmental criterion were previously identified in Attachment B to the June 13, 2000 *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects*. For Economic criteria #1-2, the values have been generated using the most recent generalized unit cost information provided by the District supplemented where necessary with additional information taken from recent contract experience on the ECP. Estimated unit costs for land acquisition were furnished to Burns & McDonnell by the District. Economic analyses are based on a 50-year period of analysis, beginning January 1, 2007 and extending through 2056. The discount rate employed was 6-3/8%, consistent with current USACE guidance for planning studies. An escalation rate of 3% per year was also employed in the analyses. The Present Worth of each alternative is reported as of December 31, 2002.

Table 1.4: Summary of Evaluation Criteria used for each ECP Alternative

Criteria			**Unit**	**Value**	**Source of Data**
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes		
		50-Year TP Load Disc. - Alternative	tonnes		
		Phosphorus Load Reduction	%		
	2a	Long-term flow-weighted mean TP concentration	ppb		
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb		
3	Implementation Schedule		years		
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)		
5	Resiliency to extreme conditions		-4 (worst) +4 (best)		
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)		
7	Management of side streams		-3 (worst) +3 (best)		
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)		
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$		
	2	Total 50-Year TP Removal	kg		
	2	Cost-effectiveness	$/kg		

1.4 Generalized Evaluation Criteria for SAV and PSTA

The primary assessment of the evaluation criteria for the SAV and PSTA technologies come from the STSOC documents prepared for each technology. As stated in Section 1.3, these sources of information are primarily intended for Technical Performance Evaluation criteria #3-7 and Environmental Evaluation criterion #1. The issue of the increase in storage beyond that provided by the existing STAs is not covered in STSOC, but discussed where applicable in these criteria since it significantly impacts many aspects of STA operations and maintenance.

1.4.1 Evaluation Criteria for SAV

The Supplemental Technology Standards of Comparison (STSOC) Analysis document used to assess the following criteria values in this section for the SAV technology is *Conceptual Design and Planning Level Cost Estimates for a Full-Scale Submerged Aquatic Macrophyte/Limerock System* – STSOC (DB Environmental et al, Feb 2002).

<u>Technical Performance Evaluation Criterion No. 3: Implementation Schedule</u>

The implementation schedule for a full-scale STA from start of design to treatment stabilization includes time required to design, construct, acquire land, and achieve full treatment capacity including treatment start-up and stabilization. The SAV STSOC includes an estimate that is based on a internal retrofit design similar to STA-2 with limerock berms, as shown in Table 1.5. Another 1-3 years was added to achieve a fully functional SAV System.

Table 1.5: Implementation Schedule for SAV Systems

Activity	Time	Start Month - End Month
Engineering design; final construction methods selection	2 months	0-2
Final engineering and preparation ofdesign plans and specifications; hydraulic modeling	9 months	3-12
Bidding and contractor selection	3 months	9-12
Dewatering of STA-2 and time for sediment consolidation	6 months	6-12
Construction, assuming 7 berms constructed at 400 ft of berm/day	12 months	13-25
Startup - eradication of invasive species and establishment of SAV	12 months	26-38

The SAV STSOC assumed that a portion of the existing STA will be used for the SAV technology, thus excludes consideration for land acquisition.

Technical Performance Evaluation Criterion No. 4: Operational Flexibility

Of the three components in the operational flexibility criterion (peak flow attenuation, available storage capacity, effect on green space and wildlife habitat), only one, the available storage capacity, is briefly discussed. The SAV STSOC states that water storage in a SAV-based STA will be comparable to that of existing STA designs. Since water storage is related to peak flow attenuation, SAV-based STAs should also have similar peak flow attenuation as existing STAs as well. Both of these criterion components are ultimately related to an increase in storage beyond that provided by the existing design as this storage increase will allow both water storage and peak flow attenuation to improve; without this increase in storage, there would be no significant net effect on storage or peak flow attenuation. The criterion's other component, effect on green space and wildlife habitat, is related to the location of the proposed SAV-based STA. If the proposed location is already in green space (as for conversion of some part of an existing STA to SAV), there will be no net positive effect. However, for this component, there is a considerable net positive effect associated with converting other land uses to SAV-based STAs.

Based on the STSOC data, the best professional judgment for the criterion rating for Operational Flexibility for the SAV technology is assigned as the following:

0 if there is no increase in storage beyond that provided by the existing STA footprint
Increase in storage beyond that provided by the existing STA footprint:

+1 if the increase in storage is on existing green space (additional storage and peak flow attenuation)

+2 if the increase in storage is on lands other existing green space (increased for positive impact on green space and wildlife habitat)

<u>Technical Performance Evaluation Criterion No. 5: Resiliency to fire, flood, drought and hurricane</u>

The SAV STSOC document discusses SAV technology suitability in all four extreme conditions:

- Fire: SAV desiccates and decomposes rapidly so it should not provide fuel to support a wildfire in the even of extreme drydown
- Flood: since SAV is similar to existing STA designs, no flood damage is anticipated, and may provide some flood water storage
- Drought: SAV systems are susceptible to drought, and based on mesocosm-scale data, recovery period for an SAV community is likely to be at least four to six weeks
- Hurricane: due to the submerged nature of the vegetation, hurricane damage to an SAV system likely will be less than that to an emergent macrophyte-based system; however there is still wave runup and setup during extreme wind events

Based on the STSOC data, the best professional judgment for the criterion rating for Resiliency to Extreme Conditions for the SAV technology is assigned as the following:

+1 for Fire
+1 for Flood
-1 for Drought
0 for Hurricane
+1 for overall rating

Technical Performance Evaluation Criterion No. 6: Assessment of full-scale construction and operation

This evaluation criterion includes many different components which fall into two primary categories: history of past applications and future uncertainties related to SAV application at full-scale. The SAV STSOC document discusses both of these components:

- History: the District has demonstrated that construction and maintenance of SAV wetlands is feasible at the STA scale, and long-term functionality also has been demonstrated
- Uncertainties: a number of uncertainties have been described relating to SAV, including but not limited to sustainability and P removal effectiveness, effects of pulsed hydraulic loadings, factors affecting water budget, and drydown/reflooding performance

Based on the STSOC data, the best professional judgment for the criterion rating for Assessment of Full-Scale Construction and Operation for the SAV technology is assigned as the following:

+2 for history
-1 for uncertainties
+1 for overall rating

Technical Performance Evaluation Criterion No. 7: Management of side streams

The SAV STSOC briefly describes the level of effort required to manage side streams, describing type of side stream and method of disposal, but omits side stream volume (including seepage losses). Vegetation harvesting is not expected to be implemented in full-scale SAV wetlands; hence no residual solids management. Large amounts of marl sediments will accrue for which drydown and consolidation will be a key management technique to maintain freeboard. Side stream volume, particularly with respect to seepage losses is related to an increase in storage beyond that provided by the existing STA because this storage increase will add more seepage losses.

Based on the STSOC data and other assumptions, the best professional judgment for the criterion rating for Assessment of Management of Side Streams for the SAV technology is assigned as the following:

0 for overall rating due to no benefit derived from management of side streams
-1 for drydown/consolidation for marl sediments
-1 for overall rating (if conversion of existing STA only)
-2 for overall rating (if the alternative includes an increase in storage beyond that provided by the existing STA)

Environmental Evaluation Criterion No. 1: Level of improvement in non-phosphorus parameters

The SAV STSOC lists all 19 non-phosphorus parameters for three systems: North Test Cell 15 and South Test Cell 9 of ENR, and Cell 4 of STA-1W. Table 1.6 tabulates the average, standard deviations and number of samples for each inflow and outflow non-phosphorus measurements for SAV technology.

Table 1.6: Level of Improvement of Non-phosphorus Parameters for SAV Technology

			NTC-15			STC-9			Cell 4			
			Avg	Stdev	n	Avg	Stdev	n	Avg	Stdev	n	Value
Nutrients												
	Total Kjeldahl Nitrogen (TKN)	Inflow	2.8	0.3	2	2.5	0.2	5	1.2	0.2	2	0
	(mg/L)	Outflow	2.7	0.5	2	2.4	0.3	6	1.4	0.2	2	
	Ammonia Nitrogen (NH3-N)	Inflow	0.36	0.1	2	0.2	0.08	5	0.07	0	2	+1
	(mg/L)	Outflow	0.13	0.01	3	0.14	0.06	6	<.05	0	2	
	Nitrate-Nitrite Nitrogen (NOx-N)	Inflow	<.05	0	2	<.05	0	2	0.05	0.04	2	0
	(mg/L)	Outflow	<.05	0	2	<.05	0	2	<.05	0	2	
Metered Parameters												
	Dissolved Oxygen	Inflow	0.4	0.4	5	5.1	4.2	5	5.7	1	8	0
	(mg/L)	Outflow	14.8	2.1	5	5.6	4.4	5	4	2.1	8	
	Temperature	Inflow	29.9	1	6	29.3	1.4	6	23.5*	3.6	10	0
	(Celsius)	Outflow	31.7	2.2	6	30.1	1	6	20.9	3.7	10	
	pH	Inflow	7.22	0.12	6	7.47	0.3	6	7.9	0.05	10	0
	(units)	Outflow	7.99	0.12	6	8.56	0.28	6	7.75	0.15	10	
	Specific Conductance	Inflow	1031	66	5	1014	50	13	681	95	8	0
	(µs/cm)	Outflow	987	42	5	872	65	13	755	151	8	
	Turbidity	Inflow	2	1.4	4	1.2	0.8	12	1	0.2	8	0
	(NTU)	Outflow	1.4	0.5	4	1.9	1.1	12	0.9	0.2	8	
	Color	Inflow	389	31	5	329	21	13	240	20	8	+1
	(CPU)	Outflow	355	12	5	262	22	12	228	20	8	
Dissolved Ions												
	Sulfate	Inflow	73	2	6	64	8	6	38	17	4	0
	(mg/L)	Outflow	69	2	5	47	8	5	47	24	4	
	Silica	Inflow	6	10	6	14	13	6	13	4	4	0
	(mg/L)	Outflow	5	11	5	15	19	5	13	2	4	
	Chloride	Inflow	125	10	6	128	11	6	92	16	4	0
	(mg/L)	Outflow	123	11	5	134	7	5	104	32	4	
	Calcium	Inflow	98	2	6	91	8	6	68	18	4	0
	(mg/L)	Outflow	82	2	5	50	5	5	68	14	4	
	Magnesium	Inflow	25	1	3	25	1	6	18	0	3	0
	(mg/L)	Outflow	26	1	3	27	1	6	21	1	3	
	Sodium	Inflow	102	12	6	104	8	6	78	33	4	0
	(mg/L)	Outflow	101	13	5	106	9	5	92	34	4	
	Potassium	Inflow	8.4	0.4	6	9.8	0.5	6	11	5	4	0
	(mg/L)	Outflow	8.4	0.4	5	9.7	0.8	5	14	5	4	
Misc. Parameters												
	Alkalinity	Inflow	284	0	2	274	8	5	183	28	3	0
	(mg $CaCO_3$ /L)	Outflow	251	1	2	200	22	5	186	15	3	
Metals												
	Dissolved Iron	Inflow	54	14	6	14	5.6	6	14	2	4	0
	(µg/L)	Outflow	31	7	5	2.5	0.7	5	7	1	4	
	Dissolved Aluminum	Inflow	<.02	0	6	<.02	0	6	<.02	?*	?*	0
	(mg/L)	Outflow	<.02	0	5	<.02	0	5	<.02	?*	?*	

*reported as 33.5, but exceeds maximum value listed in table; therefore taken as 23.5
?* reported as <.02; therefore unknown

Based on the STSOC data, the best professional judgment for the environmental criterion rating for Level of Improvement in Non-Phosphorus Parameters for the SAV technology is assigned as the following:

0 for 17 parameters with no significant change
+2* for significant decrease in Ammonia Nitrogen, and Color
0 for no significant increase
+2 for overall rating

*although Dissolved Iron has decreased significantly, it is well within the FDEP Class III Standards thus, no significant benefit is gained in its further reduction; thus its value = 0

1.4.2 Evaluation Criteria for PSTA

The Supplemental Technology Standards of Comparison (STSOC) Analysis document used to assess the following criteria values in this section for the PSTA technology is *Conceptual Designs and Planning Level Cost Estimates for a Full-Scale Periphyton Stormwater Treatment Area (PSTA)* – STSOC (CH2MHill, Nov 2001)

Technical Performance Evaluation Criterion No. 3: Implementation Schedule

The implementation schedule for a full-scale STA from start of design to treatment stabilization includes time required to design, construct, acquire land, and achieve full treatment capacity including treatment start-up and stabilization. The PSTA STSOC includes an estimate that is based on implementation at STA-3/4, as shown in Table 1.7. Three to six months was assumed to be required to achieve a fully functional PSTA System, depending on season of startup (shorter times during Spring and Summer).

Table 1.7: Implementation Schedule for PSTA Systems

Activity	Time
Alternative analysis, site selection, and land acquisition	24 months
Preliminary engineering including site-specific studies	6 months
Final engineering and preparation of design drawings and specifications	6 months
Bidding and contractor selection	4 months
Construction	20 months
Startup and compliance with water quality standards	12 months

Technical Performance Evaluation Criterion No. 4: Operational Flexibility

Of the three components in the operational flexibility criterion (peak flow attenuation, available storage capacity, effect on green space and wildlife habitat), the first two are briefly discussed. The PSTA STSOC states that PSTA technology offers a high level of operational flexibility and resilience to natural perturbations, and that large water volumes can be stored within the footprint of the proposed PSTA during high rainfall events without significant impacts on performance. As with SAV technology, both of these criterion components are related to an increase in storage beyond that provided by the existing design as this storage increase will allow both water storage and peak flow attenuation to improve; without this increase in storage, there would be no significant net effect on storage or peak flow attenuation. The other criterion, effect on green space and wildlife habitat, is related to the location of the proposed PSTA. If the proposed location is already in green space (as for conversion of some part of an existing STA to PSTA), there will be no net positive effect. However, for this component, there is a considerable net positive effect associated with converting other land uses to PSTAs.

Based on the STSOC data and other assumptions, the best professional judgment for the criterion rating for Operational Flexibility for the PSTA technology is assigned based on the following guidelines:

0 if there is no increase in storage beyond that provided by the existing STA footprint
Increase in storage beyond that provided by the existing STA footprint:

- +1 if the increase in storage is on existing green space (additional storage and peak flow attenuation)
- +2 if the increase in storage is on lands other existing green space (increased for positive impact on green space and wildlife habitat)

<u>Technical Performance Evaluation Criterion No. 5: Resiliency to fire, flood, drought and hurricane</u>

The PSTA STSOC document discusses PSTA technology suitability in all four extreme conditions:

- Fire: because they have less fuel, PSTAs are not as likely to carry a wildfire as are macrophyte-dominated STAs following a drought
- Flood: no significant impacts on performance is associated with large water volume storage within the footprint of proposed PSTA during high rainfall events
- Drought: the PSTA system is currently expect to recover relatively quickly from desiccation occurring as a result of a drought. Dry-out tests have reflected the ability of the periphyton to be fully desiccated and recover its P-removal ability within hours or days following rewetting
- Hurricane: high winds are known to mobilize some periphyton, resulting in the apparent potential for movement and washout of periphyton biomass during extreme weather events. However, the concept of periphyton growing in an open matrix of sparse macrophytes appears to be relatively immune to high biomass export.

Based on the STSOC data, the best professional judgment for the criterion rating for Resiliency to Extreme Conditions for the PSTA technology is assigned as the following:

+1 for Fire

+1 for Flood

+1 for Drought

-1 for Hurricane

+2 for overall rating

Technical Performance Evaluation Criterion No. 6: Assessment of full-scale construction and operation

This evaluation criterion includes many different components which fall into two primary categories: history of past applications and future uncertainties related to PSTA application at full-scale. The PSTA STSOC document discusses both of these components:

- History: no full-scale PSTA systems have been designed, constructed, or operated nor are any of the existing PSTA systems operated to meet specific outflow discharge permit requirements. Yet, large-scale, periphyton-dominated areas have been providing water with a low TP concentration for decades, particularly areas in the southern parts of the Water Conservation Areas (WCAs) and Everglades National Park.
- Uncertainties: a number of uncertainties have been described relating to PSTA, including but not limited to response of periphyton to a range of inlet TP concentrations and flow rates, maintenance management issues, soil issues, and performance of engineered PSTA.

Based on the STSOC data, the best professional judgment for the criterion rating for Assessment of Full-Scale Construction and Operation for the PSTA technology is assigned as the following:

-1 for history
<u>-1 for uncertainties</u>
-2 for overall rating

<u>Technical Performance Evaluation Criterion No. 7: Management of side streams</u>

The PSTA STSOC briefly describes the level of effort required to manage side streams, describing type of side stream, but omits method of disposal and side stream volume. Harvesting periphyton is considered unmanageable because large quantities of wet biomass would need disposal. Consequently, the STSOC envisioned no side stream management for this technology. However, side stream volume, particularly with respect to seepage losses is related to an increase in storage beyond that provided by the existing design because this storage increase will add more seepage losses.

Based on the STSOC data, the best professional judgment for the criterion rating for Assessment of Management of Side Streams for the PSTA technology is assigned as the following:

0 for overall rating due to no benefit derived from management of side streams
<u>0 for other costs</u>
0 for overall rating (if conversion of existing STA only)
-1 for overall rating (if the alternative includes an increase in storage beyond that provided by the existing STA)

Environmental Evaluation Criterion No. 1: Level of improvement in non-phosphorus parameters

The SAV STSOC lists all 19 non-phosphorus parameters for two systems: South Test Cell 1/4 (Peat/Peat-Ca) and South Test Cell 2/5 (Shellrock) of ENR. Table 1.8 tabulates the average, standard deviations and number of samples for each inflow and outflow non-phosphorus measurements for PSTA technology. However, for Dissolved Oxygen, Temperature, pH, and Specific Conductance, only the cell average values were listed, hence a score of zero is assigned for these parameters.

Based on the STSOC data, the best professional judgment for the environmental criterion rating for Level of Improvement in Non-Phosphorus Parameters for the PSTA technology is assigned as the following:

0 for 16 parameters with no significant change

+3* for significant decrease in Ammonia and Nitrate-Nitrite Nitrogen, and Dissolved Aluminum

0# for no significant increase

+3 for overall rating

*although Calcium has decreased significantly, its presence is considered to have beneficial qualities associated with water in the Everglades; however its effect is not completely documented; thus its value = 0
#although Alkalinity decreased, it is well within the FDEP Class III Standards; thus, no significant impact, its value = 0

Table 1.8: Level of Improvement of Non-phosphorus Parameters for PSTA Technology

			STC 1/4 (Peat/Peat-Ca)			STC 2/5 (Shellrock)			
			Avg	Stdev	n	Avg	Stdev	n	Value
Nutrients									
	Total Kjeldahl Nitrogen (TKN)	Inflow	2.5	0.22	5	2.52	0.23	5	0
	(mg/L)	Outflow	2.1	1.18	5	2.55	0.27	5	
	Ammonia Nitrogen (NH3-N)	Inflow	0.08	0.06	5	0.08	0.06	5	+1
	(mg/L)	Outflow	0.02	0.01	5	0.02	0.01	5	
	Nitrate-Nitrite Nitrogen (NOx-N)	Inflow	0.15	0.05	5	0.15	0.05	5	+1
	(mg/L)	Outflow	0	0	5	0	0	5	
Metered Parameters									
	Dissolved Oxygen	Cell Avg	2.6	0.81	6	2.83	1.39	6	0
	(mg/L)								
	Temperature	Cell Avg	22.75	0.82	6	21	2.21	6	0
	(Celsius)								
	pH	Cell Avg	7.63	0.18	6	7.46	0.03	7.41	0
	(units)								
	Specific Conductance	Cell Avg	1223	39	6	1273	40	6	0
	(umhos/cm)								
	Turbidity	Inflow	1.17	0.23	6	1.17	0.23	6	0
	(NTU)	Outflow	1.5	0.35	6	1.34	0.41	6	
	Color	Inflow	156	14	6	156	14	6	0
	(CU)	Outflow	147	37	6	136	32	6	
Dissolved Ions									
	Sulfate	Inflow	54.6	1.5	4	54.6	1.5	4	0
	(mg/L)	Outflow	51.9	3.5	4	54.7	1.8	4	
	Silica	Inflow	19.2	2.7	4	19.2	2.7	4	0
	(mg/L)	Outflow	21.3	2	4	20.2	2.9	4	
	Chloride	Inflow	209.4	18.6	4	209.4	18.6	4	0
	(mg/L)	Outflow	213.8	17.7	4	213	17.3	4	
	Calcium*	Inflow	70.5	11	4	70.5	11	4	0
	(mg/L)	Outflow	43.5	4	4	60.6	3.9	4	
	Magnesium	Inflow	31.4	0	4	31.4	0	4	0
	(mg/L)	Outflow	32.8	0.6	4	31.6	0.6	4	
	Sodium	Inflow	152.1	6.5	4	152.1	6.5	4	0
	(mg/L)	Outflow	155.3	6.4	4	153.3	6.5	4	
	Potassium	Inflow	15.7	0.8	4	15.7	0.8	4	0
	(mg/L)	Outflow	15.9	1.2	4	15.6	1.2	4	
Misc. Parameters									
	Alkalinity#	Inflow	296	17	5	296	17	5	0
	(mg/L)	Outflow	235	7	5	263	13	5	
Metals									
	Dissolved Iron	Inflow	3.5	3.2	4	3.5	3.2	4	0
	(µg/L)	Outflow	3.8	1.6	4	16.4	18.2	4	
	Dissolved Aluminum	Inflow	13.8	23	4	13.8	23	4	+1
	(µg/L)	Outflow	2.7	0.9	4	2.7	0.9	4	

1.5. General Uncertainties and Key Assumptions

Presented are some of the key uncertainties identified during the Basin-Specific Feasibility Studies. They are identified to highlight areas where further studies and/or research could be undertaken to clarify the direction the SFWMD needs to take to accomplish its goals:

- The SFWMM Inflow source (2050wPROJ) was developed at a conceptual level with many uncertainties including but not limited to the influence of other CERP projects, future consumption requirements, upstream source controls (including BMPs) and regulatory actions.
- The performance of SAV and other communities estimated in the DMSTA model is based on currently available data, and can be expected to be adjusted as additional operational data becomes available.
- Within the DMSTA model itself, many assumptions were made to emulate real world conditions including but not limited to the use of Continuous Stirred Tank Reactors (CSTRs) in series as the principle mechanism of phosphorus reduction treatment. Three CSTRs were used to model each cell; the number was increased for each transverse canal, or decreased when previous inefficiencies were noted.
- The final phosphorus reduction goal has not yet been set by FDEP.

Given the above (and other) key uncertainties, development of the information and analytical results presented herein required that certain key and potentially controlling assumptions be made. Principal among those assumptions are that:

- ➢ The simulated inflow volumes and total phosphorus loads to the treatment systems are truly reflective of long-term trends, both for the regional system as it presently exists and as it may be modified due to other initiatives (such as CERP).
- ➢ The DMSTA model, which remains a work in progress, properly considers and addresses each of the physical processes and environmental influences which might govern performance of the STAs.

- The currently calibrated phosphorus reduction performance parameters in the DMSTA are truly reflective of actual performance. The calibration data sets on which those parameters are based are continuing to expand in both number and duration, with the result that the performance estimates can be expected to continue to improve with time.
- Particularly with respect to the ECP basins, that it will be possible to replicate the performance of the SAV_C4 calibration on a large scale over an extended period of time.
- That BMP performance in the EAA will continue at its current level (roughly a 50% reduction from historic TP discharges), which markedly exceeds that actually required by rule.
- The planning level target of a long-term geometric mean TP concentration of 10 ppb in discharges from the STAs will be consistent with the Class 3 standards that may be finally adopted.

Given the above uncertainties and key assumptions, it will be desirable to continue engineering process development to reduce the level of uncertainty, coupled with careful and prudent selection of initial physical and operational modifications to the STAs. It is possible that enhancements beyond those identified herein may be necessary to meet long-term water quality standards once they are established.

Table of Contents

List of Tables

List of Figures

2. STORMWATER TREATMENT AREA NO. 1, EAST AND WEST, (STA-1E, 1W)

STA-1E and STA-1W are, under certain conditions, hydraulically connected and interdependent. For that reason, they are both discussed in this Part 2.

STA-1E is situated immediately east of the Loxahatchee National Wildlife Refuge (WCA-1) and south of the C-51 Canal. It's primary source of inflow is the C-51 West Basin. Runoff from the C-51 West Basin will be introduced to STA-1E through Pumping Station S-319. An additional source of inflow to STA-1E is runoff from the Rustic Ranches subdivision. Although a part of the C-51 West basin, runoff from that area will be introduced to STA-1E through Pumping Station S-361. Discharges from STA-1E will be directed to WCA-1 though Pumping Station S-362. STA-1E, including those primary pumping stations, is presently being constructed by the Jacksonville District, USACE, and is scheduled for completion near the end of 2003.

STA-1W is situated immediately west of the Loxahatchee National Wildlife Refuge (WCA-1) and south of the L10/L12 (West Palm Beach) Canal. The primary source of inflow to STA-1W is the S-5A Basin in the Everglades Agricultural Area. Runoff from the S-5A Basin is lifted by Pumping Station S-5A to the STA-1 Inflow and Distribution Works, situated in the extreme northerly end of WCA-1. Discharges from the Inflow and Distribution Works to STA-1W are made through Structure G-302, a gated spillway in Levee L-7 (which forms the westerly perimeter of WCA-1). Discharges from STA-1W are directed to WCA-1 through pumping stations G-251 and G-310. STA-1W is complete and is presently operational.

The design of the STA-1 Inflow and Distribution Works is developed to permit the diversion and redirection of inflows between STA-1E and STA-1W. Structure G-311 will consist of a gated spillway constructed in Levee L-40, which forms the easterly perimeter of WCA-1. Runoff from the S-5A Basin can be directed to STA-1E through G-311; the current design and operation of STA-1W contemplates that redirection of flows whenever the discharge from Pumping Station S-5A exceeds the hydraulic capacity of STA-1W. In addition, runoff from the C-51 West Basin can be directed to STA-1W through G-311 as well. However, the present design of STA-1E is developed such that no such redirection would be necessary as a result of hydraulic limitations in STA-1E. The construction of G-311 is presently scheduled for completion in 2004, concurrent with the presently planned completion of STA-1E.

2.1 STA-1E Existing Conditions

Upon completion, STA-1E will provide a total effective treatment area of 5,132 acres, situated generally between the C-51 Canal (on the north) and WCA 1 (in the southwest), and west of Flying Cow Road. This stormwater treatment area is intended to treat inflows from the C-51 Canal (via Structure S-319), and G-311 via the Inflow and Distribution Basin. Those inflows are comprised of contributions from a number of sources, including:

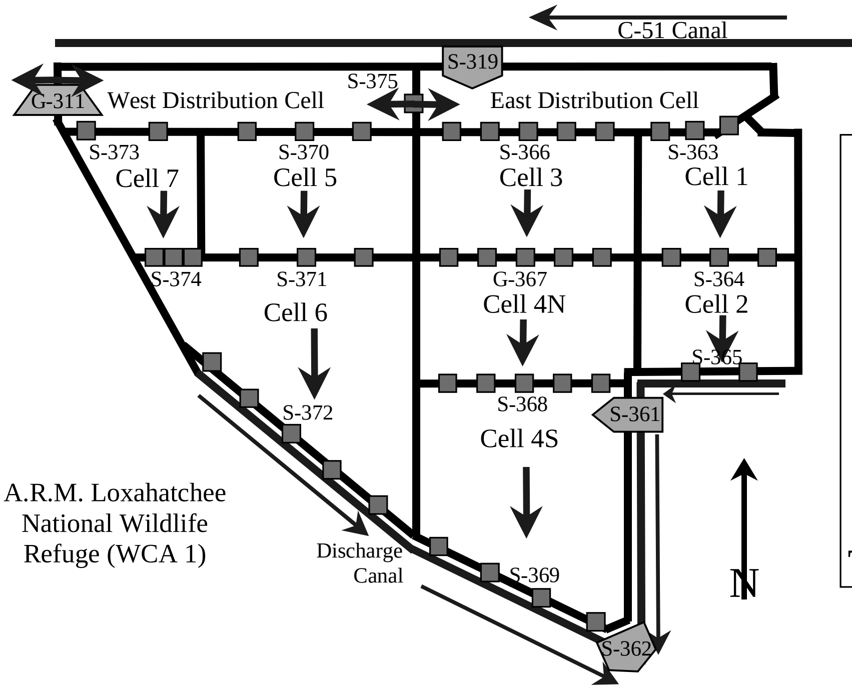
- Agricultural and urban runoff and discharges from the C-51 Basin
- Agricultural runoff and discharges from the L-101/EAA S-5A Basin
- Supplemental (irrigation) water necessary to prevent dryout of the STA from Lake Okeechobee
- Flow from the Rustic Ranches subdivision (a part of the C-51 West Basin) through Pumping Station S-361

STA-1E is being developed as essentially three parallel flow paths, each developed with cells in series, preceded by distribution cells located along and parallel to the C-51 Canal. Those distribution cells encompass 1046 acres in addition to the 5,132 acres in the STA-1E treatment cells.

A schematic of the current design of STA-1E is presented in Figure 2.1.

An analysis of Existing Conditions was prepared to assess the probable performance of STA-1E under regional conditions existing upon completion of the Everglades Construction Project, but prior to completion of other major initiatives (such as the Comprehensive Everglades Restoration Plan, or CERP). That analysis was prepared for a thirty-one year period, extending from 1965 through 1995, using simulated inflow volumes from the

District's South Florida Water Management Model (SFWMM) and inflow total phosphorus (TP) loads developed as defined in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies.* The probable performance of STA-1E in reducing total phosphorus was evaluated through use of the DMSTA software, version dated April 12, 2002 (additional information on this software is presented in Part 1).



Cell	Effective Area (ac)
1	556
2	552
3	589
4N	645
4S	752
5	571
6	1,049
7	418
Total	5,132 ac

Figure 2.1. Schematic of STA-1E

2.1.1 Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Existing Conditions for STA-1E. Daily inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Existing Conditions are included in an Excel file "1E_Baseline_ p1_Data.xls".

Inflow Volumes and TP Loads: As presented in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies*, the estimated average annual inflows to STA-1E over the 31-year period are 133,331 acre-feet per year at a flow-weighted mean inflow concentration of 176 ppb (28.95 metric tons inflow TP per year). The load estimates are relatively consistent with the loads presented in the August, 1995 *General Design Memorandum* for STA 1-E, prepared by Burns & McDonnell although the inflow quantity was previously estimated a little lower (124,900 acre-feet), with a higher inflow concentration (191 ppb). It should here be noted that the estimated inflow concentration to STA-1E from the C-51 West Basin is subject to a higher degree of uncertainty than those in any other ECP Basin, due primarily to limited historic data. While considered sufficiently conservative for this study (particularly as compared to data from Acme Basin B), actual inflow concentrations should be closely monitored and compared to this key design assumption.

Daily estimates of inflow by source were taken from an Excel spreadsheet prepared by the District in connection with preparation of the *Baseline Data* (file name "sta1E inflow tp.xls" dated May 11, 2001). Table 2.1 summarizes the estimated average annual inflow volumes and total phosphorus (TP) loads and concentrations to STA-1E represented in those daily estimates.

Table 2.1. Estimated Inflows, STA-1E Existing Analysis, 1965-1995

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
C-51 Basin	105,202	24.01	185
L-101/EAA WPB Basin (S-5A)	22,552	3.70	133
Lake Okeechobee			
Water Supply	631	0.11	141
Rustic Ranches	4,946	1.13	185
Total Average Annual Inflows	**133,331**	**28.95**	**176**

Rainfall: For the 31-year period, daily estimates of rainfall over the surface of STA-1E were taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name "2050wPROJ_rfet.xls" dated March 11, 2002;

worksheet identification “RF-STAs (inches)”). The average annual rainfall over the surface of STA-1E as reflected in that data file is estimated to be 59.09”.

Evapotranspiration: Daily estimates of evapotranspiration over the surface of STA-1E were also taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name “2050wPROJ_rfet.xls” dated March 11, 2002; worksheet identification “ET-STAs (inches)”). The average annual evapotranspiration over the surface of STA-1E as reflected in that data file is estimated to be 55.30”. It should here be noted that the daily ET values were estimated as specific to the operation of STA-1E under the 2050 “with-CERP” simulation, and may not be fully representative of ET for the baseline condition. However, the analysis is not sensitive to minor variations in ET, and further refinement of those daily estimates is considered unnecessary for feasibility-level analyses.

2.1.2 Summary of Input Variables

The following paragraphs summarize input variables employed in the analysis of Existing Conditions for STA-1E. Those input variables are defined in an Excel worksheet entitled “1E Baseline” included in the workbooks “1E_Baseline_p1_Data.xls” and “1E_Baseline_ p2_Data.xls”. Due to a 6-cell limitation in the DMSTA input parameters, two separate runs are necessary in the analysis of STA-1E. The Western and Eastern distribution cells were combined into one cell and the resulting outflows and TP loads from the DMSTA output files were utilized as inflows into the remaining cells. The distribution cells were analyzed as having poor distribution characteristics (e.g., one Continuous Stirred Tank Reactor). Cells 5 and 7 were combined into one cell, as were Cells 4N and 4S, with the resulting cells being labeled Cell 5,7 and 4NS, respectively. Other than as stated in the following, all cells were assigned as composed of 3 continuous Stirred Tank Reactors (CSTRs) in series (e.g., 3 CSTRs base in both Cell 4N and 4S, plus one CSTR for each transverse canal). Given that Cell 4S has 2 transverse canals, Cell 4NS has been assigned 8 CSTR. This method was utilized in the Baseline run as well as Alternatives 1, 2 & 3 of STA-1E.

Hydraulic Properties: Depth-discharge relationships specified in the DMSTA input file for each cell of STA-1E were based on analysis of detailed information presented in the November 2000 *Design Documentation Report (DDR) Addendum* for STA-1E, prepared by Burns & McDonnell for the Jacksonville District, USACE. A summary of that analysis is presented in Table 2.2. The outlet control depth in each cell was established at 40 cm (approx. 15"), consistent with the current design basis of STA-1E.

Table 2.2 STA-1E Hydraulic Properties, Existing Design (Baseline 2007-2056)

Cell	Area (Acre)	Mean Ground Elev.(ft. NGVD)	Discharge (cfs)	Discharge (hm*3/d)	Ave. Cell Width (km)	Mean Stage (ft. NGVD)	Mean Depth (ft)	Depth (m)	Coeff. A (m)	Exp. B	Computed Discharge (hm*3/d)	Ratio, Comp. Q/Target
1	556	17.00	94	0.230	1.55	18.00	1.00	0.305	2.44	2.36	0.230	1.00
1	556	17.00	860	2.104	1.55	19.56	2.56	0.780	2.44	2.36	2.104	1.00
2	552	15.75	113	0.276	1.46	16.75	1.00	0.305	2.94	2.31	0.276	1.00
2	552	15.75	860	2.104	1.46	18.16	2.41	0.735	2.94	2.31	2.104	1.00
3	589	15.00	47	0.114	1.56	16.00	1.00	0.305	1.12	2.29	0.114	1.00
3	589	15.00	1,540	3.768	1.56	19.59	4.59	1.399	1.12	2.29	3.768	1.00
4NS	1397	13.56	56	0.137	1.55	14.56	1.00	0.305	1.41	2.33	0.137	1.00
4NS	1397	13.56	1,594	3.899	1.55	17.76	4.20	1.281	1.41	2.33	3.899	1.00
C5-7	989	13.28	52	0.128	2.55	14.28	1.00	0.305	0.79	2.32	0.128	1.00
C5-7	989	13.28	1,580	3.866	2.55	17.63	4.35	1.326	0.79	2.32	3.866	1.00
6	1049	11.90	58	0.142	1.99	12.90	1.00	0.305	1.15	2.34	0.142	1.00
6	1049	11.90	1,580	3.866	1.99	16.00	4.10	1.250	1.15	2.34	3.866	1.00

Seepage: Generalized estimates of seepage gains or losses from STA-1E were taken from information presented in Addendum to the DDR for STA-1E, Burns & McDonnell. As presented in that reference, seepage gains or losses occur within the treatment area as well as along exterior boundaries.

A summary of the seepage gains or losses and estimated recoveries from the various cells of STA-1E, based on the information presented in the Addendum to the DDR, is illustrated by figure 2.2 (excerpted from the Addendum to the DDR) and presented in Table 2.3.

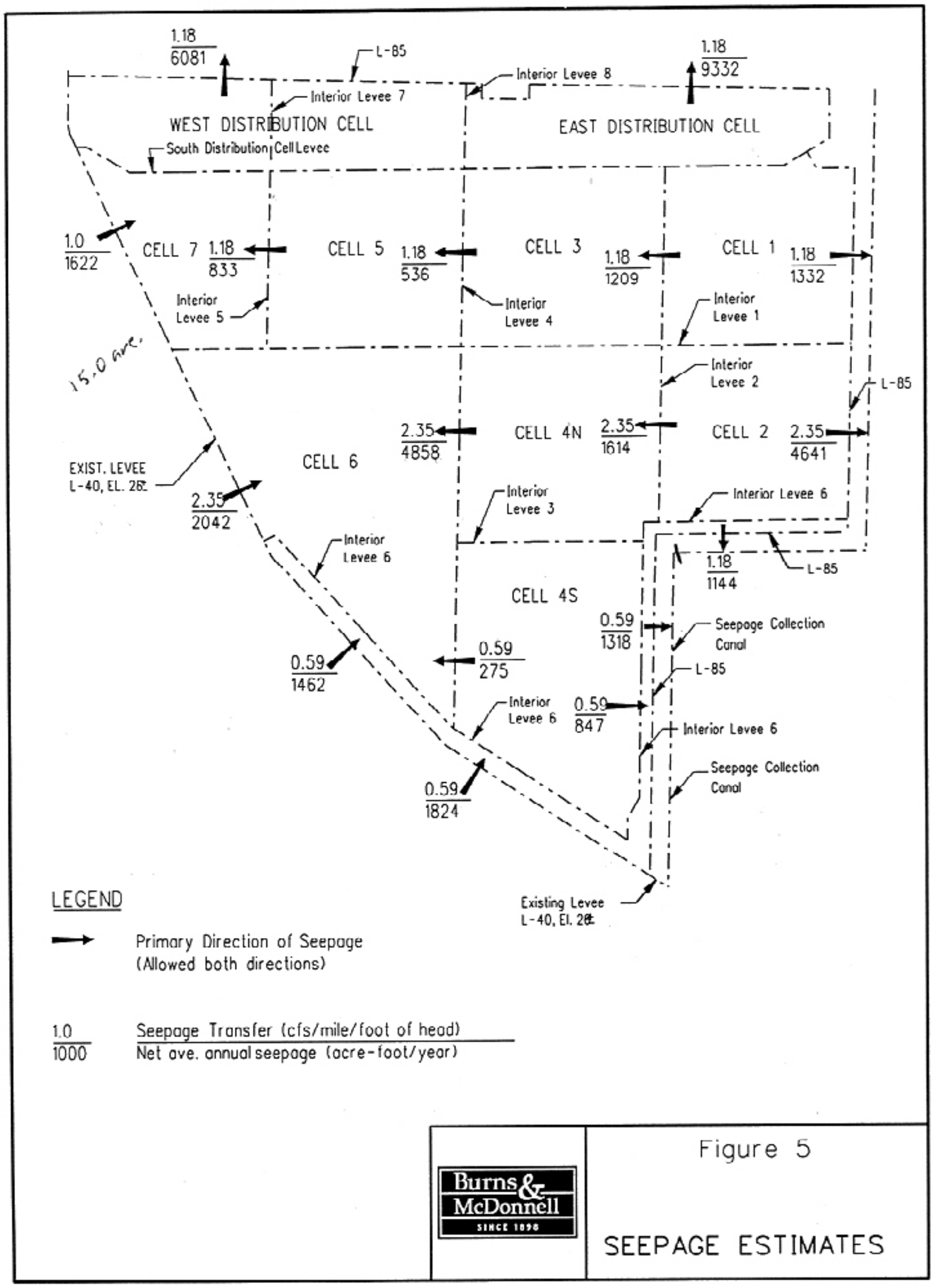


Figure 2.2. Schematic of Seepage Transfer

Table 2.3 Estimated Seepage Loss Rates and Recovery from STA-1E

Cell	Location	Length (ft)	Rate (cf/d/ft/ft))	Total Seepage (cf/day/ft)	Cell Area (ac)	Loss Rate (cm/d/cm)	% Recovery
DC	North	20,200	-19.3	-389,860	1046	-0.00856	**1.00**
1	West	4,800	-19.3	-92,640	556	-0.00383	**0.00**
	East	4,800	-19.3	-92,640	556	-0.00383	**1.00**
	Total Out					-0.00765	**0.77 Weighted**
2	West	4,800	-38.5	-184,800	552	-0.00769	**0.00**
	East	4,800	-38.5	-184,800	552	-0.00769	**1.00**
	Total Out					-0.01537	**0.81 Weighted**
3	West	4,800	-19.3	-92,640	589	-0.00361	**0.00**
	East	4,800	19.3	92,640	589	0.00361	**Inflow**
4N	West	5,300	-38.5	-204,050	645	-0.00726	**0.00**
4N	East	5,300	38.5	204,050	645	0.00726	**Inflow**
4S	West	4,800	-9.7	-46,560	752	-0.00142	**0.00**
4S	East	8,000	-9.7	-77,600	752	-0.00237	**1.00**
4NS	Seep Out				1,397	-0.00539	**0.31 Weighted**
4NS	Seep In				1,397	0.00335	**Inflow**
5	West	4,800	-19.3	-92,640	571	-0.00372	**0.00**
5	East	4,800	19.3	92,640	571	0.00372	**Inflow**
7	West	6,000	16.4	98,400	418	0.00540	**Inflow**
7	East	4,800	19.3	92,640	418	0.00509	**Inflow**
5,7	Seep Out					0.00000	**Internal to Cell**
5,7	Seep In					0.00443	**Inflow**
6	West	6,800	38.5	261,800	1,049	0.00573	**Inflow**
6	East (4N)	5,300	38.5	204,050	1,049	0.00447	**Inflow**
6	East (4S)	4,800	9.6	46,080	1,049	0.00101	**Inflow**
6	Seep In					0.01121	**Inflow**

Cell	Seepage Direction	Ave. Grade (ft. NGVD) *	Control Elev. (ft. NGVD)	Relative to Ave. Grade (ft)	Relative to Ave. Grade (cm)	Remarks
East DC	Out to N.	18	**11.5**	-6.5		9800 ft. north perimeter
West DC	Out to N.	13.5	**11.5**	-2		10400 ft. north perimeter
All DC	Out to N.	15.7	**11.5**	-4.2	-128	Control is C-51 West ave. stage
1	Out to West	17.00	**17**			Assumed mean stage in Cell 3
	Out to East	17.00	**12.5**			Seepage Canal Control Elev.
	Total Out	17.00	**14.75**	-2.25	-69	Weighted Recovery % = 0.77
2	West	15.75	**16.5**			Assumed mean stage in Cell 4N
	East	15.75	**12.5**			Seepage Canal Control Elev.
	Total Out	15.75	**14.50**	-1.25	-38	Weighted Recovery % = 0.81
3	Out to West	15.00	**16**	1	30	Assumed mean stage in Cell 5
	In From East	15.00	**19**	4	122	Assumed mean stage in Cell 1
4N	Out to West	14.50	**13.9**	-0.6	-18	Assumed mean stage in Cell 6
4N	In From East	14.50	**17.75**	3.25	99	Assumed mean stage in Cell 2
4S	Out to West	12.75	**13.90**	1.15	35	Assumed mean stage in Cell 6
4S	Out to East	12.75	**11.50**	-1.25	-38	Estimated stage in Disch. Canal
4NS	Total Out	13.56	**13.00**	-0.56	-17	Weighted Control elev.
4NS	Total In	13.56	**16.83**	3.27	100	Weighted Control elev.
5	West	14.00				Retained in Combined Cell
	East	14.00	**17**	3	91	Assumed mean stage in Cell 3
7	West	12.75	**15.75**	3	91	Mean Stage in WCA-1
	East	12.75				Originates in Combined Cell
5,7	Total In	13.47	**16.33**	2.86	87	Weighted Control elev.
6	West	11.90	**15.75**	3.85	117	Mean Stage in WCA-1
	East (4N)	11.90	**16.5**	4.6	140	Assumed mean stage in Cell 4N
	East (4S)	11.90	**14.75**	2.85	87	Assumed mean stage in Cell 4S
	Total		**15.96**	4.225	129	Weighted Control elev.

In this analysis, Cells 3 and 4NS are expected to experience both seepage gains and losses. A limitation of the DMSTA model is that all recovered seepage losses, when returned to the treatment area, are returned to the cell from which they occur. The design of STA-1E is developed to return all recovered seepage from the south and east lines of the treatment area to the Eastern Distribution Cell. That condition cannot be represented in the DMSTA analysis.

Treatment Parameters: As presently designed, STA-1E is intended to consist entirely of emergent macrohpytic marsh. Default values in the DMSTA model for Emergent communities were employed in the analysis of existing conditions.

No. of CSTRs in Series: The design of STA-1E is developed to maximize the extent to which uniform flow distribution can be developed in each cell. For analysis of existing conditions, a total of three Continuous Stirred Tank Reactors (CSTRs) in series was assigned in each cell, other than as follows. Since Cells 4N & 4S are combined, and Cell 4S has 2 transverse canals, Cell 4 is assigned 8 CSTR. The presence of those transverse deep zones can be expected to improve overall flow patterns through flow redistribution.

2.1.3 Results of DMSTA Analysis for Existing Conditions (Baseline 2007-2056)

A detailed listing of input variables employed in the analysis of Existing Conditions for STA-1E, together with a detailed listing of computed output variables resulting from that analysis, is presented in Tables 2.4 and 2.5 (which consist of screen information taken directly from the DMSTA output file).

Table 2.4 Results of DMSTA Distribution Cell Analysis STA-1E Baseline & Alternative 1

Input Variable	Units	Value
Design Case Name	-	1E_Baseline
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	1
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description:	Filename:	1E_Baseline_p1_Data.xls
Existing Baseline, Distribution Cells Emergent		

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	120.0
Flow-Wtd Conc - Without Bypass	ppb	120.0
Geometric Mean Conc	ppb	111.5
95th Percentile Conc	ppb	127.9
Freq Cell Outflow > 10 ppb	%	100%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1					
Vegetation Type	------->	EMERG					
Inflow Fraction	-	1					
Downstream Cell Number	-	0					
Surface Area	km2	4.233					
Mean Width of Flow Path	km	2.78					
Number of Tanks in Series	-	1					
Outflow Control Depth	cm	60					
Outflow Coefficient - Exponent	-	2.26					
Outflow Coefficient - Intercept	-	1.35					
Bypass Depth	cm	0					
Maximum Inflow	hm3/day	0					
Maximum Outflow	hm3/day	0					
Inflow Seepage Rate	(cm/d) / cm	0					
Inflow Seepage Control Elev	cm	0					
Inflow Seepage Conc	ppb	20					
Outflow Seepage Rate	(cm/d) / cm	0.00856					
Outflow Seepage Control Elev	cm	-128					
Max Outflow Seepage Conc	ppb	20					
Seepage Recycle Fraction	-	1					
Seepage Discharge Fraction	-	0					
Initial Water Column Conc	ppb	30					
Initial P Storage Per Unit Area	mg/m2	500					
Initial Water Column Depth	cm	50					
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*					
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*					
K = Net Settling Rate at Steady State	m/yr	*16*					
Zx = Depth Scale Factor	cm	*60*					
C0 - Periphyton	ppb	*0*					
C1 - Periphyton	ppb	*0*					
K - Periphyton	1/yr	*0.00*					
Zx - Periphyton	cm	*0*					
Sm = Transition Storage Midpoint	mg/m2	*0*					
Sb = Transition Storage Bandwidth	mg/m2	*0*					

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	0.61						0.61
Run Date	-	06/27/02						06/27/02
Starting Date for Simulation	-	01/01/65						01/01/65
Starting Date for Output	-	01/01/65						01/01/65
Ending Date	-	12/31/95						12/31/95
Output Duration	days	11322						11322
Cell Label		1						Total Outflow
Downstream Cell Label		Outflow						-
Surface Area	km2	4.233						4.2
Mean Water Load	cm/d	10.6						10.6
Max Water Load	cm/d	334.3						334.3
Inflow Volume	hm3/yr	164.6						164.6
Inflow Load	kg/yr	28971.5						28971.5
Inflow Conc	ppb	176.0						176.0
Treated Outflow Volume	hm3/yr	165.0						165.0
Treated Outflow Load	kg/yr	19794.1						19794.1
Treated FWM Outflow Conc	ppb	120.0						120.0
Total FWM Outflow Conc	ppb	120.0						120.0
Surface Outflow Load Reduc	%	31.7%						31.7%
Outflow Geometric Mean - Daily	ppb	111.5						111.5
Outflow Geo Mean - Composites	ppb	111.5						111.5
Frequency Outflow Conc > 10 ppb	%	100%						100%

Table 2.5 Results of DMSTA Analysis, STA-1E Existing Design (Baseline 2007-2056)

Input Variable	Units	Value
Design Case Name	-	1E_Baseline
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	2
Number of Iterations	-	1
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Existing, All Cells Emergent
Filename: 1E_Baseline_p2_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.1%
Flow-Wtd Conc - With Bypass	ppb	38.3
Flow-Wtd Conc - Without Bypass	ppb	38.3
Geometric Mean Conc	ppb	33.6
95th Percentile Conc	ppb	42.7
Freq Cell Outflow > 10 ppb	%	100%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4NS	5,7	6
Vegetation Type	------->	EMERG	EMERG	EMERG	EMERG	EMERG	EMERG
Inflow Fraction	-	0.2	0	0.36	0	0.44	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	2.250	2.233	2.384	5.653	4.002	4.245
Mean Width of Flow Path	km	1.55	1.46	1.56	1.55	2.50	1.99
Number of Tanks in Series	-	3	3	3	8	3	3
Outflow Control Depth	cm	40	40	40	40	40	40
Outflow Coefficient - Exponent	-	2.36	2.31	2.29	2.33	2.32	2.34
Outflow Coefficient - Intercept	-	2.44	2.94	1.12	1.41	0.79	1.15
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0.00361	0.00335	0.00443	0.01121
Inflow Seepage Control Elev	cm	0	0	122	100	87	129
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.00765	0.01537	0.00361	0.00539	0	0
Outflow Seepage Control Elev	cm	-69	-38	30	-17	0	0
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.77	0.81	0	0.31	0	0
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*15.66*	*15.66*	*15.66*	*15.66*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	0.45	0.84	1.26	2.19	2.61	3.00	3.00
Run Date	-	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1	2	3	4NS	5,7	6	Total Outflow
Downstream Cell Label		2	Outflow	4NS	Outflow	6	Outflow	-
Surface Area	km2	2.250	2.233	2.384	5.653	4.002	4.245	20.8
Mean Water Load	cm/d	4.0	3.9	6.8	3.0	5.0	4.9	2.2
Max Water Load	cm/d	53.8	55.5	91.5	37.1	66.6	58.9	29.2
Inflow Volume	hm3/yr	33.0	31.7	59.4	61.7	72.7	75.9	165.1
Inflow Load	kg/yr	3961.9	2086.3	7131.3	4809.8	8716.1	5155.9	19809.3
Inflow Conc	ppb	120.0	65.7	120.0	77.9	120.0	68.0	120.0
Treated Outflow Volume	hm3/yr	31.7	30.4	61.7	61.9	75.9	91.0	183.3
Treated Outflow Load	kg/yr	2086.3	1267.8	4809.8	2161.6	5155.9	3596.2	7025.6
Treated FWM Outflow Conc	ppb	65.7	41.7	77.9	34.9	68.0	39.5	38.3
Total FWM Outflow Conc	ppb	65.7	41.7	77.9	34.9	68.0	39.5	38.3
Surface Outflow Load Reduc	%	47.3%	39.2%	32.6%	55.1%	40.8%	30.2%	64.5%
Outflow Geometric Mean - Daily	ppb	56.1	31.7	75.0	30.7	65.5	35.1	33.6
Outflow Geo Mean - Composites	ppb	56.4	31.9	74.6	30.6	65.3	35.2	33.6
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	100%	100%	100%

A condensed summary of the results of the analysis is presented in Table 2.6, which presents the baseline discharges from STA-1E against which discharges from the various alternatives will be calculated.

Table 2.6 Discharge Summary, STA-1E Existing Conditions (Baseline 2007-2056)

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	183
Average Annual Outflow Volume	Ac-ft/yr	148,400
Average Annual Outflow TP Load	Kg/yr	7,025.6
Flow-weighted Mean TP Concentration	ppb	38
Geometric Mean TP Concentration, weekly composites	ppb	34

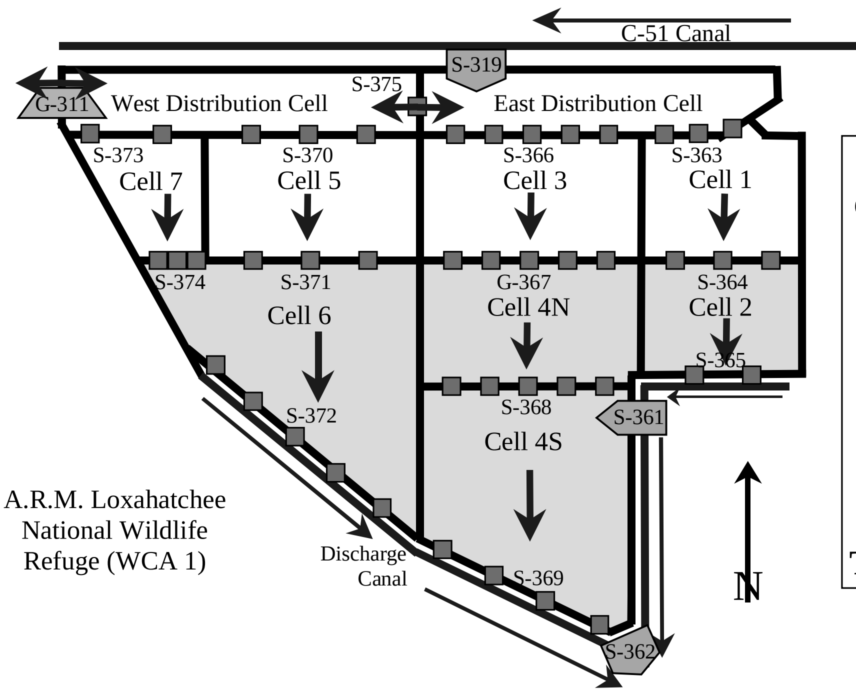
2.2 STA-1E Alternative No. 1

Under Alternative No. 1, STA-1E would be modified to optimize its performance, with completion of all modifications and placement into service of the modified treatment area occurring in 2007. For this analysis, that optimization is considered to consist of the conversion of Cells 2, 4NS, and 6 from emergent vegetation to Submerged Aquatic Vegetation (SAV_C4).

A schematic of STA-1E under Alternative 1, is presented in Figure 2.3.

2.2.1 Treatment Analysis Input Data Summary

Inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 1 are taken from the “sta1E inflow tp.xls” Excel file. Inflow volumes and TP loads are identical to those summarized in Table 2.1 Estimated Inflows, STA-1E Existing Analysis, 1965-1995. Inflow rates, TP concentrations, rainfall, and evapotranspiration employed in the DMSTA analysis of Alternative 1 were taken from this file and these input variables are defined in the Excel worksheet “1E Alternative 1” included in workbooks “1E_Alt1_p1_Data.xls” and “1E_Alt1_p2_Data.xls”. Two worksheets are used because STA-1E has more than 6 cells, the limit for the DMSTA model.



Cell	Effective Area (ac)
1	556
2	552
3	589
4N	645
4S	752
5	571
6	1,049
7	418
Total	5,132 ac

Figure 2.3. Schematic of STA-1E under Alternative 1

2.2.2 Summary of Input Variables for Treatment Analysis

Other than as discussed below, input variables employed in the analysis of Alternative 1 for STA-1E are identical to those included in the Baseline 2007-2056 Condition analysis.

- The Outflow Control Depth in Cells 2, 4NS, and 6 was modified from 40 cm to 60 cm.

- The vegetation type in Cells 2, 4NS, and 6 was revised from "Emergent" to "SAV_C4", and the associated default treatment parameters of DMSTA were employed in the analysis.

2.2.3 Results of DMSTA Analysis for Alternative 1

A detailed listing of input variables employed in the analysis of Alternative 1 for STA-1E, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 2.8 (which consists of screen information taken directly from the DMSTA output file). The first worksheet for the distribution cell analysis is not presented because it is unchanged from the baseline run. For results of the DMSTA run on the distribution cells, refer to table 2.4.

A condensed summary of the results of the analysis is presented in Table 2.7, which is considered reflective of the long-term treatment performance of STA-1E following full implementation of Alternative 1.

Table 2.7 Discharge Summary, STA-1E Alternative 1

Parameter	**Units**	**Value**
Average Annual Outflow Volume	Hm^3/yr	177
Average Annual Outflow Volume	Ac-ft/yr	143,500
Average Annual Outflow TP Load	Kg/yr	2,616.1
Flow-weighted Mean TP Concentration	ppb	15
Geometric Mean TP Concentration, weekly composites	ppb	10**

**Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

Table 2.8 Results of DMSTA Analysis, STA-1E Alternative 1

Input Variable	Units	Value
Design Case Name	-	1E_Alternative 1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	2
Number of Iterations	-	1
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Alternative 1: Southern Cells, 2, 4NS, and 6 are SAV_C4

Filename: 1E_SAV_C4_p2_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	14.8
Flow-Wtd Conc - Without Bypass	ppb	14.8
Geometric Mean Conc	ppb	7.5
95th Percentile Conc	ppb	17.2
Freq Cell Outflow > 10 ppb	%	31%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4NS	5,7	6
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.2	0	0.36	0	0.44	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	2.250	2.233	2.384	5.653	4.002	4.245
Mean Width of Flow Path	km	1.55	1.46	1.56	1.55	2.50	1.99
Number of Tanks in Series	-	3	3	3	8	3	3
Outflow Control Depth	cm	40	60	40	60	40	60
Outflow Coefficient - Exponent	-	2.36	2.31	2.29	2.33	2.32	2.34
Outflow Coefficient - Intercept	-	2.44	2.94	1.12	1.41	0.79	1.15
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0.00361	0.00335	0.00443	0.01121
Inflow Seepage Control Elev	cm	0	0	122	100	87	129
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.00765	0.01537	0.00361	0.00539	0	0
Outflow Seepage Control Elev	cm	-69	-38	30	-17	0	0
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.77	0.81	0	0.31	0	0
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	0.45	0.84	1.26	2.26	2.65	3.06	3.06
Run Date	-	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1	2	3	4NS	5,7	6	Total Outflow
Downstream Cell Label		2	Outflow	4NS	Outflow	6	Outflow	-
Surface Area	km2	2.250	2.233	2.384	5.653	4.002	4.245	20.8
Mean Water Load	cm/d	4.0	3.9	6.8	3.0	5.0	4.9	2.2
Max Water Load	cm/d	53.8	55.5	91.5	37.1	66.6	58.9	29.2
Inflow Volume	hm3/yr	33.0	31.7	59.4	61.7	72.7	75.9	165.1
Inflow Load	kg/yr	3961.9	2086.3	7131.3	4809.8	8716.1	5155.9	19809.3
Inflow Conc	ppb	120.0	65.7	120.0	77.9	120.0	68.0	120.0
Treated Outflow Volume	hm3/yr	31.7	29.9	61.7	59.4	75.9	88.1	177.3
Treated Outflow Load	kg/yr	2086.3	534.8	4809.8	724.9	5155.9	1356.4	2616.1
Treated FWM Outflow Conc	ppb	65.7	17.9	77.9	12.2	68.0	15.4	14.8
Total FWM Outflow Conc	ppb	65.7	17.9	77.9	12.2	68.0	15.4	14.8
Surface Outflow Load Reduc	%	47.3%	74.4%	32.6%	84.9%	40.8%	73.7%	86.8%
Outflow Geometric Mean - Daily	ppb	56.1	8.5	75.0	5.6	65.5	8.1	7.3
Outflow Geo Mean - Composites	ppb	56.4	8.7	74.6	5.5	65.3	8.3	7.5
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	0%	100%	40%	19%

2.2.4 Opinion of Probable Capital Cost

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 1:

- Herbicide treatment of Cells 2, 4NS and 6 for removal of emergent macrophyte vegetation to permit development of SAV.

An opinion of the probable capital cost for Alternative 1 is presented in Table 2.9.

Table 2.9 Opinion of Probable Capital Cost, STA-1E Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Eradication of Existing Vegetation	2998	ac	$200	$599,600	Unit cost from 02/2002 STSOC for SAV/LR
	Subtotal, Estimated Construction Costs				**$599,600**	**$600,000**
	Planning, Engineering & Design	10	%		$59,960	**$60,000**
	Program & Construction Management	10	%		$59,960	**$60,000**
	Total Estimated Cost, Without Contingency				**$719,520**	**$720,000**
	Contingency	30	%		$215,856	**$220,000**
	TOTAL ESTIMATED CAPITAL COST				**$935,376**	**$940,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

2.2.5 Opinion of Probable Annual Costs for Operation & Maintenance

The following is a summary listing of the anticipated incremental operation and maintenance requirements for Alternatives 1 (e.g., requirements in addition to those for operation of maintenance of STA-1E as presently designed):

- Additional herbicide treatment of Cells 2, 4NS and 6 for control of invasive species and emergent macrophyte vegetation. This item includes:
  - Annual costs to spray for invasive species.
  - Additional costs for post-drought eradication of undesirable species.

The February 22, 2002 Draft *Supplemental Technology Standard of Comparison (STSOC) Analysis for Submerged Aquatic Macrophyte/Limerock Technology*, D.B Environmental, presents an estimated cost of $25/acre/year for regular herbicide treatment for control of invasive species, and an additional $10/acre/year for post-drought eradication spraying.

The design of STA-1E varies from that of the other stormwater treatment areas of the ECP in that a considerable elevation differential exists between the upstream and downstream ends of the treatment area. As a result, the upstream cell or cells in a given flow path lie at a higher elevation than the downstream cell or cells. This change in elevation provides the capacity to discharge from the upstream (emergent) cells to the downstream (SAV_C4) cells by gravity through the outflow control structures presently included in the design of STA-1E. Given that capacity to withdraw water from the emergent cells to maintain stages in the SAV cells, the opinion of probable incremental operation and maintenance cost for this alternative includes a substantially reduced allowance of $10/acre/year for control of emergent vegetation in the SAV_C4 cells.

An opinion of the probable incremental operation and maintenance cost for Alternative 1 is presented in Table 2.10.

Table 2.10 Opinion of Probable Incremental O&M Cost, STA-1E Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Incremental Cost forAnnual Vegetation Control	2998	ac	$10	$29,980	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$29,980**	
Contingency		30 %			$8,994	
TOTAL INCREMENTAL O&M COST					**$38,974**	**$40,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

2.2.6 Total Present Worth

The total present cost of Alternative 1 is presented in Table 2.11, and is computed as of December 31, 2002. It is based on a 50-year project life (period of analysis), a discount rate of 6-3/8%, and includes escalation at an annual rate of 3%.

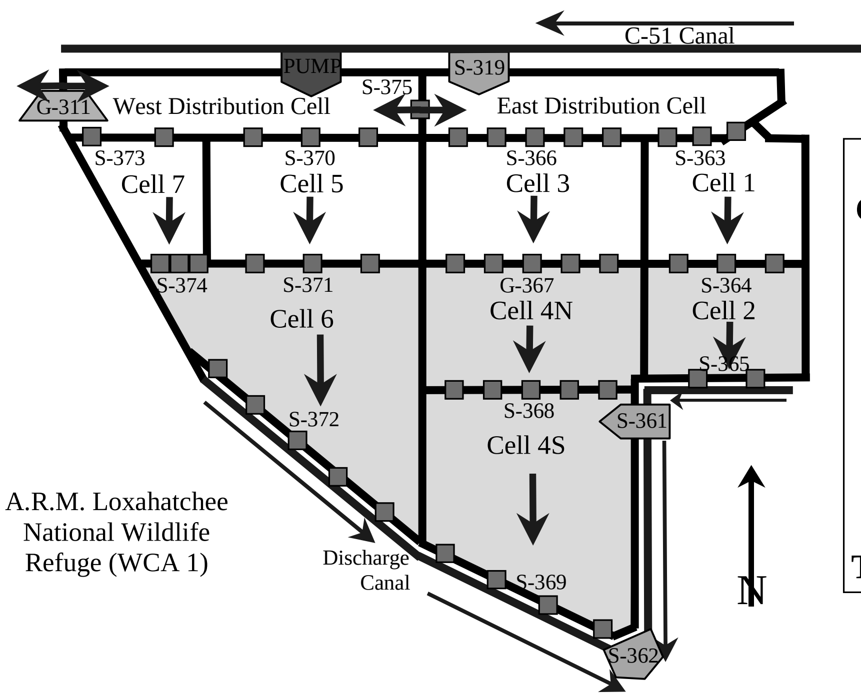
Table 2.11 Total Present Worth, STA-1E Alternative 1

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present Worth**
Year		**PED**	**P&CM**	**Const.**	**Total**	
2005		$65,564	$65,564	$896,036	$1,027,163	$853,337
Total Capital Cost					$1,027,163	$853,337
Incremental Costs for Operation and Maintenance						**Present Worth**
From	**To**			**Total O&M Cost**		
2007	2056				$5,230,499	824,950
Total Present Worth of Alternative						**$1,678,287**

2.3 STA-1E Alternative No. 2

Alternative No. 2 for STA-1E contemplates the introduction of all discharges from Acme Basin B to an enhanced or optimized STA-1E.

A schematic of STA-1E under Alternative 1, is presented in Figure 2.4.



Cell	Effective Area (ac)
1	**556**
2	**552**
3	**589**
4N	**645**
4S	**752**
5	**571**
6	**1,049**
7	**418**
Total	**5,132 ac**

Figure 2.4. Schematic of STA-1E under Alternative 2

The Acme Improvement District Basin B presently discharges directly to WCA-1 at two locations immediately southeast of STA-1E (see Figure 2.5).

Average annual discharge from Acme Basin B to WCA-a, as reported in the District's May, 2001 Baseline Data for the Basin-Specific Feasibility Studies, are estimated to be 31,499 acre-feet at a flow-weighted mean TP concentration of 94 ppb (ave. annual TP load of 3.66

metric tonnes). The Village of Wellington has adopted an ordinance requiring implementation of BMPs in Basins B, with a targeted reduction of 25% in total phosphorus discharges. Accordingly, the diversion of Basin B to STA-1E can be projected to add an average annual volume of 31,499 acre-feet at a flow-weighted mean TP of 71 ppb to the STA-1E baseline inflows.

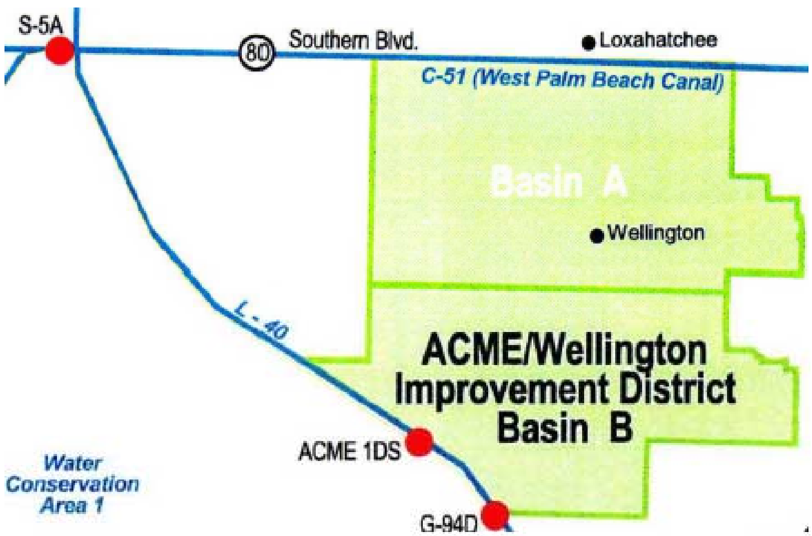


Figure 2.5. Schematic of Acme Basin B Discharge to WCA1

STA-1E inflows modified to include Acme Basin B are summarized in Table 2.12.

Under Alternative No. 2, STA-1E, receiving additional inflows from the ACME Basin, would be modified to optimize its performance, with completion of all modifications and placement into service of the modified treatment area occurring in 2006. For this analysis, that optimization is considered to consist of the conversion of Cells 2, 4NS and 6 from emergent vegetation to Submerged Aquatic Vegetation (SAV_C4) and further includes the redistribution of 3% of the total inflow from Cells 5,7 to Cell 3.

Table 2.12 Estimated Inflows, STA-1E Alternative 2, 1965-1995

Inflow Source and Description	Average Annual Inflow Volume (ac-ft)	TP Load (1,000 kg)	Flow-Weighted Mean TP Conc. (ppb)
C-51 Basin	105,202	24.01	185
L-101/EAA WPB Basin (S-5A)	22,552	3.70	133
Lake Okeechobee			
Water Supply	631	0.11	141
Rustic Ranches	4,946	1.13	185
ACME Basin*	31,499	2.74	71
Total Average Annual Inflows	**164,830**	**31.69**	**156**

* Assumes 25% reduction due to BMPs in Acme Basin B

2.3.1 Treatment Analysis Input Data Summary

The District's Excel file "acme-simulated-flow-tp.xls" provided simulated inflow volumes and TP concentrations for the ACME Basin B. The same file renamed "sta1E Alt2 inflow tp.xls", was used as a data file for inflow rates and TP concentrations for Alternative 2. Inflow rates, TP concentrations, rainfall, and evapotranspiration employed in the DMSTA analysis of Alternative 2 were taken from this file and these input variables are defined in the Excel worksheet "1E ALT 2 SAVC4" included in workbooks "1E_Alt2_p1_Data.xls" and "1E_Alt2_ p2_Data.xls". Two worksheets are again used because STA-1E has more than 6 cells, the limit for the DMSTA model.

2.3.2 Summary of Input Variables for Treatment Analysis

As previously discussed above, input variables employed in the analysis of Alternative 2 for STA-1E are identical to those included in the Alternative 1 analysis. The only variations in Alternative 2 are listed below.

- 3% of the Total Inflow to Cells 5,7 was redirected to Cell 3 by modifying the inflow fractions, (e.g., inflow fraction to Cells 5,7 was reduced from 0.44 to 0.41).

2.3.3 Results of DMSTA Analysis for Alternative 2

A detailed listing of input variables employed in the analysis of Alternative 2 for STA-1E, together with a detailed listing of computed output variables resulting from that analysis, is presented in Tables 2.14 and 2.15 (which consists of screen information taken directly from the DMSTA output file).

A condensed summary of the results of the analysis is presented in Table 2.13, which is considered reflective of the long-term treatment performance of STA-1E following full implementation of Alternative 2. STA-1E would operate under Alternative 2 from 2007-2056.

Table 2.13 Discharge Summary, STA-1E Alternative 2

Parameter	**Units**	**Value**
Average Annual Outflow Volume	Hm^3/yr	215.8
Average Annual Outflow Volume	Ac-ft/yr	175,000
Average Annual Outflow TP Load	Kg/yr	3,310.4
Flow-weighted Mean TP Concentration	ppb	15
Geometric Mean TP Concentration, weekly composites	ppb	10**

**Computed GeoMean Conc. Less than LSC assigned as 10 ppb.

Table 2.14 Results of Distribution Cell DMSTA Analysis, STA-1E Alternative 2

Case Description: Alternative 2 Includes ACME inflows with 25% BMP controls
Filename: 1E_Baseline_ACME_p1_Data.xls

Input Variable	Units	Value
Design Case Name	-	_Baseline_Acm
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	1
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	113.2
Flow-Wtd Conc - Without Bypass	ppb	113.2
Geometric Mean Conc	ppb	105.4
95th Percentile Conc	ppb	120.7
Freq Cell Outflow > 10 ppb	%	100%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1					
Vegetation Type	------->	EMERG					
Inflow Fraction	-	1					
Downstream Cell Number	-	0					
Surface Area	km2	4.233					
Mean Width of Flow Path	km	2.78					
Number of Tanks in Series	-	1					
Outflow Control Depth	cm	60					
Outflow Coefficient - Exponent	-	2.26					
Outflow Coefficient - Intercept	-	1.35					
Bypass Depth	cm	0					
Maximum Inflow	hm3/day	0					
Maximum Outflow	hm3/day	0					
Inflow Seepage Rate	(cm/d) / cm	0					
Inflow Seepage Control Elev	cm	0					
Inflow Seepage Conc	ppb	20					
Outflow Seepage Rate	(cm/d) / cm	0.00856					
Outflow Seepage Control Elev	cm	-128					
Max Outflow Seepage Conc	ppb	20					
Seepage Recycle Fraction	-	1					
Seepage Discharge Fraction	-	0					
Initial Water Column Conc	ppb	30					
Initial P Storage Per Unit Area	mg/m2	500					
Initial Water Column Depth	cm	50					
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*					
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*					
K = Net Settling Rate at Steady State	m/yr	*16*					
Zx = Depth Scale Factor	cm	*60*					
C0 - Periphyton	ppb	*0*					
C1 - Periphyton	ppb	*0*					
K - Periphyton	1/yr	*0.00*					
Zx - Periphyton	cm	*0*					
Sm = Transition Storage Midpoint	mg/m2	*0*					
Sb = Transition Storage Bandwidth	mg/m2	*0*					

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	0.61						0.61
Run Date	-	07/23/02						07/23/02
Starting Date for Simulation	-	01/01/65						01/01/65
Starting Date for Output	-	01/01/65						01/01/65
Ending Date	-	12/31/95						12/31/95
Output Duration	days	11322						11322
Cell Label		1						Total Outflow
Downstream Cell Label		Outflow						-
Surface Area	km2	4.233						4.2
Mean Water Load	cm/d	13.2						13.2
Max Water Load	cm/d	363.5						363.5
Inflow Volume	hm3/yr	203.5						203.5
Inflow Load	kg/yr	31718.4						31718.4
Inflow Conc	ppb	155.9						155.9
Treated Outflow Volume	hm3/yr	203.9						203.9
Treated Outflow Load	kg/yr	23085.9						23085.9
Treated FWM Outflow Conc	ppb	113.2						113.2
Total FWM Outflow Conc	ppb	113.2						113.2
Surface Outflow Load Reduc	%	27.2%						27.2%
Outflow Geometric Mean - Daily	ppb	105.4						105.4
Outflow Geo Mean - Composites	ppb	105.4						105.4
Frequency Outflow Conc > 10 ppb	%	100%						100%

Table 2.15 Results of DMSTA Analysis, STA-1E Alternative 2

Input Variable	Units	Value
Design Case Name	-	E Alt 2 SAV_C4
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	2
Number of Iterations	-	1
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename:** **1E_Alt2_SAV_C4_p2_Data.xls**

ACME inflow and concentrations added to original inflows
Redistributed flows for cells 3 and 5
SAV_C4 in cells 2, 4, and 6
25% BMP controls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	15.3
Flow-Wtd Conc - Without Bypass	ppb	15.3
Geometric Mean Conc	ppb	8.2
95th Percentile Conc	ppb	18.3
Freq Cell Outflow > 10 ppb	%	39%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4NS	5,7	6
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.2	0	0.39	0	0.41	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	2.250	2.233	2.384	5.653	4.002	4.245
Mean Width of Flow Path	km	1.55	1.46	1.56	1.55	2.50	1.99
Number of Tanks in Series	-	3	3	3	8	3	3
Outflow Control Depth	cm	40	60	40	60	40	60
Outflow Coefficient - Exponent	-	2.36	2.31	2.29	2.33	2.32	2.34
Outflow Coefficient - Intercept	-	2.44	2.94	1.12	1.41	0.79	1.15
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0.00361	0.00335	0.00443	0.01121
Inflow Seepage Control Elev	cm	0	0	122	100	87	129
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.00765	0.01537	0.00361	0.00539	0	0
Outflow Seepage Control Elev	cm	-69	-38	30	-17	0	0
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.77	0.81	0	0.31	0	0
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	0.52	0.90	1.32	2.26	2.65	3.06	3.06
Run Date	-	07/24/02	07/24/02	07/24/02	07/24/02	07/24/02	07/24/02	07/24/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1	2	3	4NS	5,7	6	Total Outflow
Downstream Cell Label		2	Outflow	4NS	Outflow	6	Outflow	-
Surface Area	km2	2.250	2.233	2.384	5.653	4.002	4.245	20.8
Mean Water Load	cm/d	5.0	4.8	9.1	4.0	5.7	5.6	2.7
Max Water Load	cm/d	63.8	64.8	117.5	47.7	73.6	65.1	34.6
Inflow Volume	hm3/yr	40.8	39.5	79.6	81.7	83.7	86.8	204.0
Inflow Load	kg/yr	4620.7	2670.9	9010.4	6542.0	9472.5	5878.0	23103.6
Inflow Conc	ppb	113.2	67.6	113.2	80.0	113.2	67.7	113.2
Treated Outflow Volume	hm3/yr	39.5	37.6	81.7	79.3	86.8	99.0	215.8
Treated Outflow Load	kg/yr	2670.9	686.9	6542.0	1036.7	5878.0	1586.8	3310.4
Treated FWM Outflow Conc	ppb	67.6	18.3	80.0	13.1	67.7	16.0	15.3
Total FWM Outflow Conc	ppb	67.6	18.3	80.0	13.1	67.7	16.0	15.3
Surface Outflow Load Reduc	%	42.2%	74.3%	27.4%	84.2%	37.9%	73.0%	85.7%
Outflow Geometric Mean - Daily	ppb	59.5	9.5	79.3	6.1	66.5	8.9	8.0
Outflow Geo Mean - Composites	ppb	59.8	9.7	79.0	6.1	66.3	9.2	8.2
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	0%	100%	40%	25%

2.3.4 ACME Basin B Diversion, Description of Physical Works

Alternative 2 require the diversion of flows from Acme Basin B to STA-1E. Acme Basin B presently discharges to the Loxahatchee National Wildlife Refuge (WCA-1) through two pumping stations situated on Levee L-40. Pumping Station No. 1 is located approximately one mile southeasterly along L-40 from its intersection with Flying Cow Road (extended). This station has a permitted capacity of 100,000 gpm, and is also equipped with 75,000 gpm of standby pumping capacity. Pumping Station No. 2 is located approximately 1.4 miles southeasterly along L-40 from Pumping Station No. 1. The permitted capacity of this station is 120,000 gpm; it is also equipped for an irrigation withdrawal rate (from WCA-1) of 60,000 gpm. These stations are reportedly in need of major rehabilitation, which has been deferred pending determination of the long-term water management strategies for Basin B.

Two basic options are available for diversion of discharges from those present pumping station locations to the headworks (e.g., distribution cells) of STA-1E:

> **Option 1:** The first option would consist of enlargement of approximately 4.5 miles of the Acme C-1 Canal and the Acme C-27 Canal (approximately one mile in length). It might also be necessary to enlarge approximately one mile each of the Acme C-25 and C-4 canals, leading from Pumping Station No. 2 to Pumping Station No. 1. Determination of the required extent and magnitude of the enlargement would require specific analysis of the existing canals.
>
> Those canal enlargements would extend northerly to a point north of the existing FPL transmission lines, which would require an extension of the C-1 Canal beyond a major electrical substation immediately east of Flying Cow Road. Discharges would then be carried across Flying Cow Road through a new culvert, and then conveyed west to the vicinity of the east line of the East Distribution Cell with a new canal. It should be noted that the new canal would

intersect the seepage collection canal now being constructed along the east line of STA-1E, potentially requiring the construction of a control structure on that seepage canal immediately south of its confluence with the new Acme canal. A new pumping station would then lift those discharges into the East Distribution Cell. For this analysis, the capacity of the pumping station has been assigned at 491 cfs, equal to the presently permitted discharge capacity of Pumping Stations 1 and 2 combined.

Option 2: It has been reported (personal communication with Mock Ross & Associates, engineer for the Village of Wellington, dated May 31, 2001) that a preliminary hydraulic analysis has been prepared that suggests it may be possible to convey Basin B runoff north through Basin A using the existing canal system. That diversion could be accomplished through operation (opening) of existing culverts beneath Pierson Road (the divide between Basins A and B).

Discharges from Basin A to the C-51 West Canal are presently effected through two pumping stations (total permitted discharge capacity of 120,000 gpm in the pumping stations; 60,000 gpm of standby capacity is also present in one station) and four gravity outfalls. Two of the gravity outfalls are collocated with the pumping stations (at the north ends of the C-2 and C-9 canals). The other two gravity outfalls are located at the north ends of the C-8 and C-14 canals. The Village of Wellington is also pursuing authority to construct an additional 75,000 gpm of pumping capacity from Basin A to the C-51 West Canal.

Once introduced to the C-51 Canal, the Basin B discharges would be lifted to the East Distribution Cell of STA-1E by a new pumping station constructed on the south bank of the C-51 Canal. As was the case for Option 1, that pumping station is assumed to have a capacity of 491 cfs.

The nominal capacities of Inflow Pumping Station S-319 and Outflow Pumping Station S-362 are 3,980 cfs and 4,200 cfs, respectively. The District's *Baseline Data* includes mean daily inflows at S-319 equal to its nominal capacity. Following addition of Acme Basin B discharges to the STA-1E baseline inflows, the modified peak daily inflow to STA-1E would be 6,285 cfs. It is therefore considered appropriate to consider an additional inflow pumping capacity equal to the presently permitted capacities of the Acme Basin B pumping stations (491 cfs).

The maximum simulated discharge from STA-1E over the 31-year period 1965-1995 with Acme Basin B discharges added to STA-1E, is 4,090 cfs, as compared to the nominal capacity at S-362 of 4,200 cfs. As the peak daily outflow for the 31-year period is less than the capacity of S-362, it is concluded that no bypass would have been required, and that there would not be a need for additional outflow pumping capacity.

For this analysis, it has been assumed Option 2 would be selected, and no costs have been included for the diversion of Acme Basin B to the C-51 West Canal. The only capital construction necessary for further directing those discharges to STA-1E would be the new 491-cfs inflow pumping station. Increased conveyance capacity may be needed for a portion of the C-51W Canal to accommodate the additional flows, however, no costs have been included for this potential conveyance capacity increase.

2.3.5 Opinion of Probable Capital Cost

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 2:

- Basin B discharges would be lifted to the East Distribution Cell of STA-1E by a new pumping station constructed on the south bank of the C-51 Canal.
- Herbicide treatment of Cells 2, 4NS and 6 for removal of emergent macrophyte vegetation to permit development of SAV_C4.

An opinion of the probable capital cost for Alternative 2 is presented in Table 2.16.

Table 2.16 Opinion of Probable Capital Cost, STA-1E Alternative 2

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Pumping Station, Cell	491	cfs	$9,900	$4,860,900	Unit cost from Evaluation Methodology
2	Eradication of Existing Vegetation	2998	ac	$200	$599,600	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$5,460,500**	**$5,460,000**
Planning, Engineering & Design		10 %			$546,050	**$545,000**
Program & Construction Management		10 %			$546,050	**$545,000**
Total Estimated Cost, Without Contingency					**$6,552,600**	**$6,550,000**
Contingency		30 %			$1,965,780	**$1,970,000**
TOTAL ESTIMATED CAPITAL COST					**$8,518,380**	**$8,520,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

2.3.6 Opinion of Probable Annual Costs for Operation & Maintenance

The following is a summary listing of the anticipated <u>incremental</u> operation and maintenance requirements for Alternative 2 (e.g., requirements in addition to those for operation of maintenance of STA-1E as presently designed):

- Additional herbicide treatment of Cells 2, 4NS and 6 for control of invasive species and emergent macrophyte vegetation including:
  - Operation and maintenance of one pumping station to handle Basin B discharges to the East Distribution Cell constructed on the south bank of the C-51 Canal. The pumps in this station are anticipated to be diesel driven.
  - Annual costs to spray for invasive species.
  - Additional costs for post-drought eradication of undesirable species.

The February 22, 2002 Draft *Supplemental Technology Standard of Comparison (STSOC) Analysis for Submerged Aquatic Macrophyte/Limerock Technology*, D.B

Environmental, presents an estimated cost of $25/acre/year for regular herbicide treatment for control of invasive species, and an additional $10/acre/year for post-drought eradication spraying. The opinion of probable incremental operation and maintenance cost includes a substantially reduced allowance of $10/acre/year for both those items, as was discussed for Alternative 1.

An opinion of the probable incremental operation and maintenance cost for Alternative 2 is presented in Table 2.17.

Table 2.17 Opinion of Probable Incremental O&M Cost, STA-1E Alternative 2

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Mech. Maintenance, Pumping Station	2	Ea.	$10,000	$20,000	Unit cost from Evaluation Methodology
2	Engine Operator/Maintenance Mechanic	3	Ea.	$50,000	$150,000	Unit cost from Evaluation Methodology
3	Fuel Costs	38,654	ac-ft	$0.50	$19,327	Avg. Annual Provided by SFWMD "ACME_SUM.xls"
4	Incremental Cost forAnnual Vegetation Control	2,998	ac	$10	$29,980	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$219,307**	
Contingency		30 %			$65,792	
TOTAL INCREMENTAL O&M COST					**$285,099**	**$285,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

2.3.7 Total Present Worth

The total present cost of Alternative 2 is presented in Table 2.18, and is computed as of December 31, 2006. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and includes escalation at an annual rate of 3%.

Table 2.18 Total Present Worth, STA-1E Alternative 2

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
Capital Costs						**Present**
Year		**PED**	**P&CM**	**Const.**	**Total**	**Worth**
2003		$561,350			$561,350	$527,709
2004			$289,095	$3,941,244	$4,230,339	$3,738,488
2005			$297,768	$4,059,481	$4,357,249	$3,619,876
Total Capital Cost					$4,357,249	$7,886,072
Incremental Costs for Operation and Maintenance						**Present**
From	**To**			**Total O&M Cost**		**Worth**
2007	2056				$37,267,308	5,877,768
Total Present Worth of Alternative						**$13,763,841**

2.4 Summary of Evaluation Criteria Scoring

The following tables present summaries of the evaluation criteria scoring for the alternative water quality improvement strategies for STA-1E. The information presented therein will subsequently be employed by the District and others in further evaluation of the alternatives, and identification of that alternative or alternative(s) to be carried forward to the conceptual design phase.

Table 2.19 Summary Evaluation Criteria Scores, STA-1E Alternative 1

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	351	Table 2.6
		50-Year TP Load Disc. - Alternative 1	tonnes	131	Table 2.7
		Phosphorus Load Reduction	%	62.8	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	15	Table 2.7
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10**	Table 2.7
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$1,678,287	Table 2.11
	2	Total 50-Year TP Removal	kg	220,475	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$7.61	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus

Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002
- Discount Rate of 6-3/8%

** Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

Table 2.20 Summary Evaluation Criteria Scores, STA-1E Alternative 2

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline#	tonnes	489	Table 2.6 + ACME B (2.74 tpy)
		50-Year TP Load Disc. - Alternative 2	tonnes	166	Table 2.13
		Phosphorus Load Reduction	%	66.1	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	15	Table 2.13
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10**	Table 2.13
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$13,763,841	Table 2.18
	2	Total 50-Year TP Removal	kg	323,010	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$42.61	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002
- Discount Rate of 6-3/8%

Baseline discharge consists of the sum of baseline discharge of 7.03 tonnes per year from Table 2.6, and the baseline discharge from Acme Basin B to WCA-1 (2.74 tonnes per year, see Table 2.12)
** Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

2.5 Sensitivity Analyses of Phosphorus Reduction Parameters

The effectiveness of phosphorus reduction in the alternatives considered are examined with respect to the change in the following three input parameters presented in the sensitivity analyses:

- Varying BMP Performance
- Different SAV Communities
- All Input Parameters
  - Uncertainty Analysis

The third analysis (all input parameters) also employs an uncertainty analysis. The information presented therein will assist the District in further analyses of the alternatives presented in the future evaluation of the parameters.

2.5.1 Variation in BMP Performance

The alternatives performed in the BMP sensitivity analysis for STA-1E involved the following variations in inflow loads:

- Sensitivity Normal (existing conditions – no reductions necessary)
  - C-51 Basin – 0% reduction in TP loads
  - L-101/EAA WPB Basin – 50% reduction in TP loads
  - L.O. Water Supply – 0% reduction in TP loads
  - Rustic Ranch – 0% reduction in TP loads
  - ACME Basin B– 25% reduction in TP loads
- Sensitivity Analysis #1
  - C-51 Basin – 25% reduction in TP loads
  - L-101/EAA WPB Basin – 75% reduction in TP loads
  - L.O. Water Supply – 0% reduction in TP loads
  - Rustic Ranch – 25% reduction in TP loads

  - ACME Basin B– 50% reduction in TP loads

- Sensitivity Analysis #2
  - C-51 Basin – 0% reduction in TP loads
  - L-101/EAA WPB Basin – 25% reduction in TP loads
  - L.O. Water Supply – 0% reduction in TP loads
  - Rustic Ranch – 0% reduction in TP loads
  - ACME Basin B– 0% reduction in TP loads

A summary of the results of those analyses is presented in Table 2.21.

Table 2.21 Variation in BMP Performance

Condition	Location	TP Conc. For BMP Load Reduction					
		Normal		Sens. #1		Sens. #2	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
Baseline, Existing	STA-1E Inflows	176	--	127	--	187	--
	STA-1E Outflows	38	34	31	27	38	35
Alternative 1	STA-1E Inflows	176	--	127	--	187	--
	STA-1E Outflows	15	10**	14*	10**	14*	10**
Alternative 2 (with ACME)	STA-1E Inflows	156	--	111	--	170	--
	STA-1E Outflows	15	10**	14*	10**	15	10**

*Computed F.W.M. Conc. Less than LSC assigned as 14 ppb.
**Computed GeoMean Conc. Less than LSC assigned as 10 ppb.

2.5.2 Variation in SAV Performance

The current vegetative community (SAV_C4) was changed to the vegetative community (NEWS) to determine the effects of different vegetative communities on the phosphorus reduction parameters. Table 2.22 summarizes, for Alternatives 1 and 2, the outcome of the phosphorus reduction performance due to different SAV communities.

Table 2.22 Variation in SAV Performance

Condition	Location	TP Conc. For Different SAV Communities			
		SAV_C4		NEWS	
		F.W.	Geo.	F.W.	Geo.
Alternative 1	STA-1E Inflows	176	--	176	--
	STA-1E Outflows	15	10**	24	11
Alternative 2 (with ACME)	STA-1E Inflows	156	--	156	--
	STA-1E Outflows	15	10**	24	11

**Computed GeoMean Conc. Less than LSC assigned as 10 ppb.

2.6.3 All Input Variables (DMSTA Sensitivity Model)

The sensitivity of the phosphorus reduction performance to all input variables available in the DMSTA model was tested through its built-in Sensitivity Model which also includes an Uncertainty Analysis module. The Sensitivity Model assesses the average percent change in these four output parameters for each input changed:

- Treated Flow-weighted Mean Outflow Concentration
- Total Flow-weighted Mean Outflow Concentration
- Outflow Geometric Mean – Composite
- Total Outflow Load

Due to the limitation of the DMSTA model, the sensitivity analysis is performed only on Cells 1-7 of STA-1E, not on the Distribution Cells. For Cells 1-7, a Sensitivity Scale Factor of 25% (i.e. 25% change in each input) was used in all runs. Both high and low results were tested; in other words, two runs were conducted for each input variable, one at 75% and the other at 125% of the original value of the input variable under consideration. With approximately 25 different input variables, multiplied by the number of cells in the STA, and the high and low end of results tested, the Sensitivity Analysis included a potential of 180 or more DMSTA runs for each case.

No change in output from each run for each case exceeded 25%. The biggest changes in the four output variables, consistently across each case, was caused by the input variable, Inflow Fraction.

The DMSTA Model also includes an Uncertainty Analysis which lists the actual change of any one of the four above-listed output variables based on the "uncertainty" of the input variables. If one of the 23 variables (available in this analysis) under consideration is insensitive, then the range of values will not change significantly.

The DMSTA Uncertainty Analysis uses results from the above Sensitivity Model. The input into the model is the variable labeled "Error CV", which is the Standard Error divided by the Mean. The default input Error CV in the DMSTA model was utilized for the analyses. The outputs are the 10^{th}, 50^{th}, and 90^{th} percentile estimate of the four listed output parameters.

Since the analysis of STA-1E includes no bypass analysis, the resultant Total Flow-weighted Mean Outflow Concentration is the same as the resultant Treated Flow-weighted Mean Outflow Concentration. Outputs from the four DMSTA cases are shown in Table 2.23:

Table 2.23 Uncertainty Analyses of All Input Variables

Condition	Location	TP Conc. For BMP Load Reduction in STA-1E								
		10th Percentile Est.			50th Percentile Est.			90th Percentile Est.		
		F.W.	Geo.	Load	F.W.	Geo.	Load	F.W.	Geo.	Load
Baseline, Existing	STA-1E Outflows	29	25	5,349	38	34	7,026	47	42	8,703
Alternative 1	STA-1E Outflows	14*	10**	2,479*	15	10**	2,616	18	10**	3,231
Alternative 2 (with ACME)	STA-1E Outflows	14*	10**	3,034*	15	10**	3,310	19	10	4,085

*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

The results show that there is a fairly wide range of uncertainty in phosphorus reduction performance, particularly in the baseline conditions.

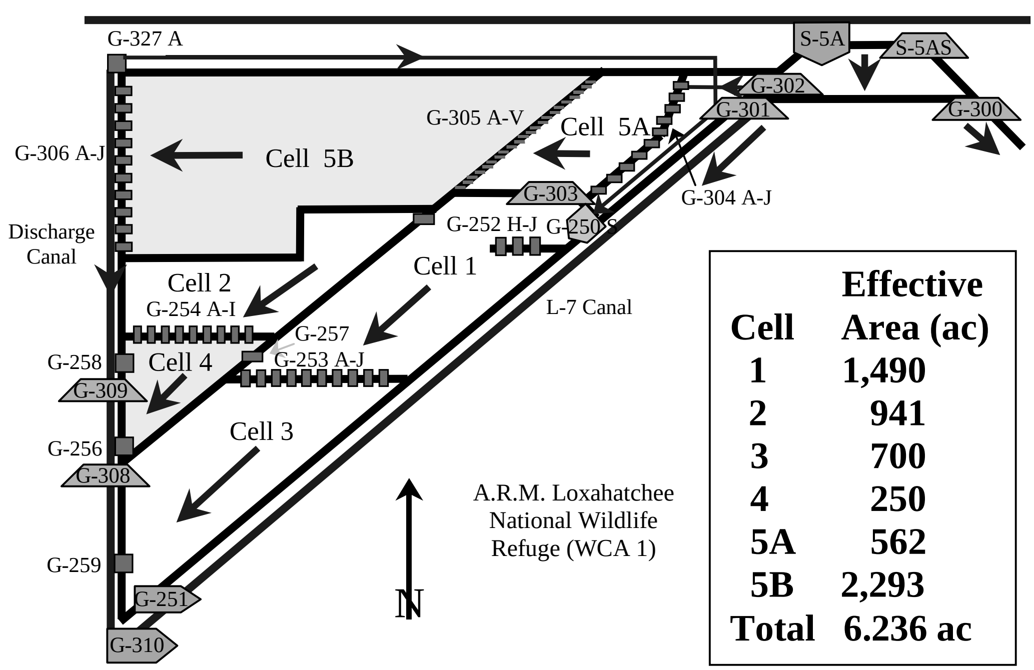
2.6 STA-1W Baseline Conditions

STA-1W provides a total effective treatment area of 6,670 acres, generally bounded by the Ocean Canal (on the north) and Water Conservation Area 1 (on the east and south). Those inflows are comprised of contributions from a number of sources, including:

- Agricultural runoff and discharges from the S-5A Basin
- WPB Canal BMP MUW
- Supplemental (irrigation) water necessary to prevent dryout of the STA from Lake Okeechobee

STA-1W has three flow paths, each developed with cells in series. The northern path flows in a westerly direction and the eastern and western path flows in a southerly direction. Cells 1 through 4 comprise the original Everglades Nutrient Removal (ENR) project. All cells have emergent macrophytic vegetative communities except Cells 4 and 5B which have SAV.

A schematic of the current design of STA-1W is presented in Figure 2.6.



Cell	Effective Area (ac)
1	1,490
2	941
3	700
4	250
5A	562
5B	2,293
Total	6.236 ac

Figure 2.6. Schematic of STA-1W

An analysis of Existing Conditions was prepared to assess the probable performance of STA-1W under regional conditions existing upon completion of the Everglades Construction Project, but prior to completion of other major initiatives (such as the Comprehensive Everglades Restoration Plan, or CERP). That analysis was prepared for a thirty-one year period, extending from 1965 through 1995, using simulated inflow volumes from the District's South Florida Water Management Model (SFWMM) and inflow total phosphorus (TP) loads developed as defined in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies.* The probable performance of STA-1W in reducing total phosphorus was evaluated through use of the DMSTA software, version dated April 12, 2002 (additional information on this software is presented in Part 1).

2.6.1 Model Configuration

STA-1W is the most hydrologically complex of the various STAs completed or now being constructed under the Everglades Construction Project. It encompasses a number of unique features that directly impact its modeled configuration.

Cells 1 through 4 consist of the original Everglades Nutrient Removal (ENR) Project. The ENR Project was constructed on available lands, with the result that the overall footprint of the project was triangular in nature. The net effect of that overall configuration is that the hydraulic capacities of Cells 3 and 4 are limited to peak rates of flow well below the rates intended upon completion of STA-1W. Structure G-308 (on the west side of Cell 3) and Structure G-309 (on the west side of Cell 4) were added during construction of STA-1W to permit discharge of peak rates of flow in advance of the "funnels" at the lower ends of the treatment cells. Those structures are each fed by an east-west canals extending across the cell served by the structure.

The model of STA-1W is structured on the assumption that the bulk of discharges from Cells 3 and 4 are passed through G-308 and G-309, respectively, rendering the bulk of the treatment cells' areas downstream of those structures as largely ineffective for treatment. In this analysis, the effective treatment area in Cell 3 is reduced from 1,026 to 700 acres; the effective treatment area in Cell 4 is reduced from 358 to 250 acres.

Cells 1 and 3 immediately abut the Loxahatchee National Wildlife Refuge (WCA-1), with the result that significant seepage from the Refuge to those cells can be anticipated. While that alone is not unusual (other STAs will also experience seepage inflows from adjacent water bodies), an unusual feature in STA-1W is the presence of the seepage collection canal extending north from Pumping Station G-250. That seepage collection canal lies between the STA-1W Inflow Canal across the east end of Cell 5A and the Refuge. As a result, seepage will be induced to that canal from both the Refuge and Cell 5A. That induced seepage is included in the model as upwelling seepage in Cell 1 of STA-1W. The model also was structured to incorporate estimated seepage inflows from the Refuge directly to Cells 1 and 3, and seepage from Cells 1 and 3 to Cells 2 and 4.

Each of Cells 1 through 4 has been documented as having relatively poor flow distribution characteristics. In Cells 1 and 3, the poor flow distribution is considered to result from a combination of “side-tipping” (e.g., the cell floor topography slopes down from east to west), and the presence of remnant agricultural canals, particularly those oriented in the north-south direction.

In Cells 2 and 4, a significant short circuit remains along the east perimeter, consisting of the remnants of a borrow canal excavated to facilitate construction of the FPL access roadway forming the east levee of those cells. In addition, flows are distributed across the north end of Cell 2 by simple overflow of the south bank of a Distribution Canal along the north levee of Cell 2. The shorter flow path (and slightly lower ground surface elevations) in the westerly part of Cell 2 results, during significant inflow events, in a flow imbalance favoring the westerly part of the cell, resulting in higher-than-desirable flow velocities in the marsh. Those elevated velocities tend to “clear a path” through the marsh, which further compounds the flow imbalance in the cell.

A further complicating factor in the operation of STA-1W is the limited capability to effectively control the distribution of inflows between Cells 1 and 2. Structure G-255, which controls inflows to Cell 2, is controlled by stop logs and cannot be readily adjusted to maintain desirable flow distributions between the two flow paths. In addition, the headwater elevation at G-225 is driven by stages in the Cell 1 and 3 marshes, which are not subject to precise estimation. While in the remainder of the STAs the distribution of inflows is generally based on a uniform aerial loading, the inflow fractions assigned to the various flow paths of STA-1W have been imbalanced in this analysis, with roughly 50% assigned to Cells 5A and 5B, and the remainder evenly divided between Cells 1/3 and 2/4.

2.6.2 Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Existing Conditions for STA-1W. Daily inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Existing Conditions are included in an Excel file "1W_baseline_Data.xls".

Inflow Volumes and TP Loads: As presented in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies*, the estimated average annual inflows to STA-1W over the 31-year period are 160,334 acre-feet per year at a flow-weighted mean inflow concentration of 139 ppb (27.40 metric tons inflow TP per year).

Daily estimates of inflow by source were taken from an Excel spreadsheet prepared by the District in connection with preparation of the *Baseline Data* (file name "sta1w inflow tp.xls" dated May 10, 2001). Table 2.24 summarizes the estimated average annual inflow volumes and total phosphorus (TP) loads and concentrations to STA-1W represented in those daily estimates.

Table 2.24 Estimated Inflows, STA-1W Existing Analysis, 1965-1995

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
S-5A Basin	139,891	23.86	138
WPB Canal BMP MUW	20,149	3.49	140
Lake Okeechobee			
Water Supply	294	0.05	141
Total Average Annual Inflows	**160,334**	**27.40**	**139**

Rainfall: For the 31-year period, daily estimates of rainfall over the surface of STA-1W were taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name "2050wPROJ_rfet.xls" dated March 11, 2002; worksheet identification "RF-STAs(inches)"). The average annual rainfall over the surface of STA-1W as reflected in that data file is estimated to be 56.24".

Evapotranspiration: Daily estimates of evapotranspiration over the surface of STA-1W were also taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name "2050wPROJ_rfet.xls" dated March 11, 2002; worksheet identification "ET-STAs(inches)"). The average annual evapotranspiration over the surface of STA-1W as reflected in that data file is estimated to be 55.45". It should here be noted that the daily ET values were estimated as specific to the operation of STA-1W under the 2050 "with-CERP" simulation, and may not be fully representative of ET for the baseline condition. However, the analysis is not sensitive to minor variations in ET, and further refinement of those daily estimates is considered unnecessary for feasibility-level analyses.

2.6.3 Summary of Input Variables

The following paragraphs summarize input variables employed in the analysis of Existing Conditions for STA-1W. Those input variables are defined in an Excel worksheet entitled "Baseline" included in the workbook "1W_baseline_Data.xls".

Hydraulic Properties: Depth-discharge relationships specified in the DMSTA input file for each cell of STA-1W were based on analysis of detailed information presented in the *Operation Plan Stormwater Treatment Area 1 West*, January 2001. A summary of that analysis is presented in Table 2.25. The outlet control depth in each cell was established at 40 cm (approx. 15") and 60 cm for emergent and SAV communities, respectively, consistent with the current design basis of STA-1W.

Table 2.25 STA-1W Hydraulic Properties, Existing Design (Baseline 2007-2056)

Cell	Area (Acre)	Mean Ground Elev.(ft. NGVD)	Discharge (cfs)	Discharge (hm*3/d)	Ave. Cell Width (km)	Mean Stage (ft. NGVD)	Mean Depth (ft)	Depth (m)	Coeff. A (m)	Exp. B	Computed Discharge (hm*3/d)	Ratio, Comp. Q/Target
1	1490	10.10	34	0.084	1.1	11.10	1.00	0.305	1.24	2.35	0.084	1.00
1	1490	10.10	930	2.275	1.1	14.18	4.08	1.244	1.24	2.35	2.275	1.00
2	941	9.50	50	0.121	1.74	10.50	1.00	0.305	1.38	2.51	0.121	1.00
2	941	9.50	850	2.080	1.74	12.60	3.10	0.945	1.38	2.51	2.080	1.00
3	676	10.40	53	0.131	2.48	11.40	1.00	0.305	1.03	2.50	0.131	1.00
3	676	10.40	930	2.275	2.48	13.53	3.13	0.954	1.03	2.50	2.275	1.00
4	307.7	9.70	49	0.119	1.83	10.70	1.00	0.305	1.28	2.50	0.119	1.00
4	307.7	9.70	850	2.080	1.83	12.83	3.13	0.954	1.28	2.50	2.080	1.00
5A	562	9.50	104	0.253	1.78	10.50	1.00	0.305	2.75	2.49	0.253	1.00
5A	562	9.50	1,470	3.597	1.78	12.40	2.90	0.884	2.75	2.49	3.597	1.00
5B	2293	9.50	249	0.610	2.34	10.50	1.00	0.305	3.78	2.25	0.610	1.00
5B	2293	9.50	1,470	3.597	2.34	11.70	2.20	0.671	3.78	2.25	3.597	1.00

Seepage: A summary of the seepage inflows and losses (and estimated recoveries) from the various cells of STA-1W, based on the information presented in the January 2001 *Operation Plan Stormwater Treatment Area 1 West*, is presented in Table 2.26.

As presented in the January, 2001 *Operation Plan Stormwater Treatment Area 1 West,* Cells 1, 3, & 5A receive seepage inflows from the WCA1 Area. The design of STA-1W is developed to return all recovered seepage from the north lines of the treatment area to the upstream end of Cell 1. That condition cannot be represented in the DMSTA analysis.

Table 2.26 Estimated Seepage Loss Rates and Recovery from STA-1W

Cell	Location	Length (ft)	Rate (cf/d/ft/ft))	Total Seepage (cf/day/ft)	Cell Area (ac)	Loss Rate (ft/d/ft)	Loss Rate (m/yr/m)	% Recovery
1	East Line	14,000	16.5	231,000	1,490	0.00356	1.299	**Inflow**
Seep Canal	WCA-1	6,700	33.0	221,100	1,490	0.00341	1.243	**Inflow**
Seep Canal	5A	6,700	33.0	221,100	1,490	0.00341	1.243	**Inflow**
1	Seep In				1,490	0.01038	3.789	**Inflow**
1	West Line	13,600	16.5	224,400	1,490	0.00346	1.262	**0**
2	East Line	13,600	16.5	224,400	941	0.00547	1.998	**Inflow**
3	East Line	12,500	16.5	206,250	700	0.00676	2.469	**Inflow**
3	West Line	3,200	16.5	52,800	700	0.00173	0.632	**0**
4	East Line	3,200	16.5	52,800	250	0.00485	1.770	**Inflow**
5A	North Line	5,000	33.0	165,000	562	0.00674	2.460	**80**
	East Line	6,700	33.0	221,100	562	0.00903	3.297	**100**
	Total	(Similar control elevation both locations)				0.01577	5.757	**91**
5B	North Line	15,000	33.0	495,000	2,293	0.00496	1.809	**80**

Cell	Location	Ave. Grade (ft. NGVD) *	Control Elev. (ft. NGVD)	Relative to Ave. Grade (ft)	Relative to Ave. Grade (cm)	Remarks
1	East Line	10.10	**15.75**	5.65		Mean Stage in WCA-1
1	Seep. Canal	8.00	**15.75**	7.75		Head Diff., WCA-1 to Seep Canal
1	Seep. Canal	8.00	**11.5**	3.5		Head Diff., Cell 5A to Seep Canal
1	Total In	10.10	**16.1**	6	183	Weighted Ave. for Net Inflows
1	West (Out)	10.10	**11.5**	1.4	43	Assumed mean stage in Cell 2
2	East (In)	9.50	**12.8**	3.3	101	Assumed mean stage in Cell 1
3	East Line	10.40	**15.75**	5.35	163	Mean Stage in WCA-1
3	West Line	10.40	**11.7**	1.3	40	Assumed mean stage in Cell 4
4	East Line	9.70	**12.4**	2.7	82	Assumed mean stage in Cell 3
5A	North Line	9.50	**8**	-1.5	-46	Seepage Canal Control Elevation
	East Line	9.50	**8**	-1.5	-46	Seepage Canal Control Elevation
5B	North Line	9.50	**8**	-1.5	-46	Seepage Canal Control Elevation

Treatment Parameters: As presented in the January, 2001 *Operation Plan Stormwater Treatment Area 1 West*, Cells 1 and 3 of STA-1W are composed of 67% emergent macrophytic marsh and 33% SAV. Cells 2 and 4 have 33% emergent and 67% SAV vegetation, respectively. The composition of STA-1W is assigned as emergent for Cells 1-3, and SAV_C4 for Cell 4. Cell 5A is emergent vegetation while its downstream cell, 5B is presently developed in SAV. Default values in the DMSTA model for Emergent and SAV_C4 communities were employed in the analysis of existing conditions.

No. of CSTRs in Series: For analysis of existing conditions, Cells 1, 2, 3, and 4 are described as 2 CSTRs in series to account for documented short-circuiting. The short-circuiting results from both remnant agricultural canals generally parallel to flow paths, and from side-tipped topography in Cells 1 and 3. Cell 5A is described with 2 CSTRs in series due to the short flow path. Cell 5B is input as 2.5 CSTRs in series due to the presence of remnant agricultural canals, while recognizing its larger area and much longer flow path.

2.6.4 Results of DMSTA Analysis for Existing Conditions (Baseline 2007-2056)

A detailed listing of input variables employed in the analysis of Existing Conditions for STA-1W, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 2.28 (which consists of screen information taken directly from the DMSTA output file).

A condensed summary of the results of the analysis is presented in Table 2.27.

Table 2.27 Discharge Summary, STA-1W Existing Conditions (Baseline 2007-2056)

Parameter	**Units**	**Value**
Average Annual Outflow Volume	Hm^3/yr	232
Average Annual Outflow Volume	Ac-ft/yr	188,100
Average Annual Outflow TP Load	Kg/yr	5,653.5
Flow-weighted Mean TP Concentration	ppb	24
Geometric Mean TP Concentration, weekly composites	ppb	24

Table 2.28 Results of DMSTA Analysis, STA-1W Existing Design (Baseline 2007-2056)

Case Description: **Filename:** **1W_baseline_Data.xls**

Existing, Cells 1-3 & 5A--Emergent & Cell 4 & 5B--SAV_C4

Input Variable	Units	Value
Design Case Name	-	Baseline
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.1%
Flow-Wtd Conc - With Bypass	ppb	24.3
Flow-Wtd Conc - Without Bypass	ppb	24.3
Geometric Mean Conc	ppb	24.1
95th Percentile Conc	ppb	30.5
Freq Cell Outflow > 10 ppb	%	45%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4	5A	5B
Vegetation Type	------->	EMERG	EMERG	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.25	0.25	0	0	0.5	0
Downstream Cell Number	-	3	4	0	0	6	0
Surface Area	km2	6.030	3.808	2.833	1.012	2.274	9.279
Mean Width of Flow Path	km	1.10	1.74	2.48	1.83	1.78	2.34
Number of Tanks in Series	-	2	2	2	2	2	3
Outflow Control Depth	cm	55	67	46	60	60	60
Outflow Coefficient - Exponent	-	2.35	2.51	2.5	2.5	2.49	2.25
Outflow Coefficient - Intercept	-	1.24	1.38	1.03	1.28	2.75	3.78
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.01038	0.00547	0.00676	0.00485	0	0
Inflow Seepage Control Elev	cm	183	101	163	82	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.00346	0	0.00173	0	0.01577	0.00496
Outflow Seepage Control Elev	cm	43	0	40	0	-46	-46
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0	0	0	0	0.91	0.8
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	0.77	5.16	9.52	13.90	18.32	23.00	23.00
Run Date	-	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1	2	3	4	5A	5B	Total Outflow
Downstream Cell Label		3	4	Outflow	Outflow	5B	Outflow	-
Surface Area	km2	6.030	3.808	2.833	1.012	2.274	9.279	25.2
Mean Water Load	cm/d	2.2	3.6	7.4	14.1	11.9	2.9	2.1
Max Water Load	cm/d	12.9	20.5	31.5	89.5	68.6	17.8	12.4
Inflow Volume	hm3/yr	49.5	49.5	77.1	52.2	99.0	97.8	197.9
Inflow Load	kg/yr	6854.8	6854.8	3322.8	3258.3	13709.6	9597.4	27419.3
Inflow Conc	ppb	138.5	138.5	43.1	62.4	138.5	98.1	138.5
Treated Outflow Volume	hm3/yr	77.1	52.2	85.0	52.6	97.8	94.6	232.2
Treated Outflow Load	kg/yr	3322.8	3258.3	2626.0	1599.5	9597.4	1428.0	5653.5
Treated FWM Outflow Conc	ppb	43.1	62.4	30.9	30.4	98.1	15.1	24.3
Total FWM Outflow Conc	ppb	43.1	62.4	30.9	30.4	98.1	15.1	24.3
Surface Outflow Load Reduc	%	51.5%	52.5%	21.0%	50.9%	30.0%	85.1%	79.4%
Outflow Geometric Mean - Daily	ppb	39.3	55.6	29.1	21.8	89.4	8.8	25.0
Outflow Geo Mean - Composites	ppb	39.7	56.2	29.2	22.8	91.4	9.3	24.1
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	100%	100%	100%

2.6.5 Model Verification

STA-1W is now in full operation. W.W. Walker, Jr. PhD furnished a file containing measured discharge and phosphorus concentration data for the 15-month period extending from January 1, 2001 through March 31, 2002 in personal communication. A summary of the "measured" inflows to and outflows from STA-1W over that period is presented in Table 2.29. Inflows are based on the data presented for Structure G-302 (the single inflow structure to STA-1W). Outflows are the summation of measured discharges at Pumping Stations G-251 and G-310.

The "Existing Conditions" model for STA-1W was applied to the inflow series (inflows at G-302, rainfall and ET) taken from that data set, and the outflows computed for comparison to the measured outflows. Analyses were conducted assuming both SAV_C4 and NEWS in both Cells 4 and 5B.

Table 2.29 Measured STA-1W Inflows and Outflows, 01/01/01-03/31/02

Parameter	**Units**	**Inflow (at –G-302)**	**Outflow (G-251+G-310)**
Volume	Ac-ft	242,079	270,165
TP Load	Kg	44,054	12,286
Flow-Weighted (F.W.) Mean TP Conc.	ppb	147.3	36.9
Geo. Mean TP Conc. In Outflows Daily 7-day F.W. Means	 ppb ppb	 N.A. N.A.	 30.9 31.0
Total Rainfall During Period (Volume based on nominal STA surface area of 6,670 acres)	in Ac-ft	54.66 30,382	N.A.
Total Evapotranspiration During Period (Volume based on nominal STA surface area of 6,670 acres)	in Ac-ft	N.A.	65.01 36,135
Estimated Seepage Inflow (for overall water balance)	Ac-ft	33,839	N.A.

Tables 2.30 and 2.31 present the analytical results for the DMSTA analyses, consisting of screen information taken directly from the DMSTA output files.

Table 2.30 STA-1W Predicted Performance 01/01/01-03/31/02, with SAV_C4

Case Description: 7 Day Composite; Walker Data Series - G302 Inflows; Existing, Cells 1-3 & 5A--Emergent & Cell 4 & 5B--SAV_C4

Filename: 1W_7Day_G302_Data.xls

Input Variable	Units	Value
Design Case Name	-	eline SAV_C4 G3
Starting Date for Simulation	-	01/01/01
Ending Date for Simulation	-	03/31/02
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	4
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	29.4
Flow-Wtd Conc - Without Bypass	ppb	29.4
Geometric Mean Conc	ppb	26.7
95th Percentile Conc	ppb	34.6
Freq Cell Outflow > 10 ppb	%	52%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4	5A	5B
Vegetation Type	------->	EMERG	EMERG	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.25	0.25	0	0	0.5	0
Downstream Cell Number	-	3	4	0	0	6	0
Surface Area	km2	6.030	3.808	2.833	1.012	2.274	9.279
Mean Width of Flow Path	km	1.10	1.74	2.48	1.83	1.78	2.34
Number of Tanks in Series	-	2	2	2	2	2	3
Outflow Control Depth	cm	55	67	46	60	60	60
Outflow Coefficient - Exponent	-	2.35	2.51	2.5	2.5	2.49	2.25
Outflow Coefficient - Intercept	-	1.24	1.38	1.03	1.28	2.75	3.78
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.01038	0.00547	0.00676	0.00485	0	0
Inflow Seepage Control Elev	cm	183	101	163	82	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.00346	0	0.00173	0	0.01577	0.00496
Outflow Seepage Control Elev	cm	43	0	40	0	-46	-46
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0	0	0	0	0.91	0.8
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.61	3.21	4.82	6.42	8.83	11.24	11.24
Run Date	-	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02
Starting Date for Simulation	-	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01
Starting Date for Output	-	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01
Ending Date	-	03/31/02	03/31/02	03/31/02	03/31/02	03/31/02	03/31/02	03/31/02
Output Duration	days	455	455	455	455	455	455	455
Cell Label		1	2	3	4	5A	5B	Total Outflow
Downstream Cell Label		3	4	Outflow	Outflow	5B	Outflow	-
Surface Area	km2	6.030	3.808	2.833	1.012	2.274	9.279	25.2
Mean Water Load	cm/d	2.7	4.3	8.3	16.7	14.4	3.5	2.6
Max Water Load	cm/d	17.1	27.1	32.4	103.8	90.7	22.2	16.3
Inflow Volume	hm3/yr	60.0	60.0	85.9	61.8	119.9	118.3	239.9
Inflow Load	kg/yr	8835.0	8835.0	4171.8	4319.3	17669.9	13278.2	35339.9
Inflow Conc	ppb	147.3	147.3	48.6	69.8	147.3	112.3	147.3
Treated Outflow Volume	hm3/yr	85.9	61.8	93.1	62.1	118.3	113.2	268.3
Treated Outflow Load	kg/yr	4171.8	4319.3	3266.9	2323.3	13278.2	2300.7	7890.9
Treated FWM Outflow Conc	ppb	48.6	69.8	35.1	37.4	112.3	20.3	29.4
Total FWM Outflow Conc	ppb	48.6	69.8	35.1	37.4	112.3	20.3	29.4
Surface Outflow Load Reduc	%	52.8%	51.1%	21.7%	46.2%	24.9%	82.7%	77.7%
Outflow Geometric Mean - Daily	ppb	39.3	58.7	30.7	28.8	98.2	12.4	27.0
Outflow Geo Mean - Composites	ppb	39.8	57.2	30.9	29.0	97.3	12.8	26.7
Frequency Outflow Conc > 10 ppb	%	100%	#DIV/0!	100%	#DIV/0!	#DIV/0!	#DIV/0!	100%

Table 2.31 STA-1W Predicted Performance 01/01/01-03/31/02, with NEWS

Input Variable	Units	Value
Design Case Name	-	aseline News G30
Starting Date for Simulation	-	01/01/01
Ending Date for Simulation	-	03/31/02
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	4
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: 7 Day Composite
Walker Data Series - G302 Inflows
Existing, Cells 1-3 & 5A--Emergent & Cell 4 & 5B--News

Filename: 1W_7Day_G302_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	38.2
Flow-Wtd Conc - Without Bypass	ppb	38.2
Geometric Mean Conc	ppb	28.1
95th Percentile Conc	ppb	48.4
Freq Cell Outflow > 10 ppb	%	61%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4	5A	5B
Vegetation Type	------->	EMERG	EMERG	EMERG	NEWS	EMERG	NEWS
Inflow Fraction	-	0.25	0.25	0	0	0.5	0
Downstream Cell Number	-	3	4	0	0	6	0
Surface Area	km2	6.030	3.808	2.833	1.012	2.274	9.279
Mean Width of Flow Path	km	1.10	1.74	2.48	1.83	1.78	2.34
Number of Tanks in Series	-	2	2	2	2	2	3
Outflow Control Depth	cm	55	67	46	60	60	60
Outflow Coefficient - Exponent	-	2.35	2.51	2.5	2.5	2.49	2.25
Outflow Coefficient - Intercept	-	1.24	1.38	1.03	1.28	2.75	3.78
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.01038	0.00547	0.00676	0.00485	0	0
Inflow Seepage Control Elev	cm	183	101	163	82	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.00346	0	0.00173	0	0.01577	0.00496
Outflow Seepage Control Elev	cm	43	0	40	0	-46	-46
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0	0	0	0	0.91	0.8
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*12*	*4*	*12*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*15.66*	*128.70*	*15.66*	*128.70*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*4*	*0*	*4*
C1 - Periphyton	ppb	*0*	*0*	*0*	*22*	*0*	*22*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*23.80*	*0.00*	*23.80*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*400*	*0*	*400*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*80*	*0*	*80*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	3.21	5.62	7.22	9.63	12.04	15.25	15.25
Run Date	-	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02	06/27/02
Starting Date for Simulation	-	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01
Starting Date for Output	-	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01	01/01/01
Ending Date	-	03/31/02	03/31/02	03/31/02	03/31/02	03/31/02	03/31/02	03/31/02
Output Duration	days	455	455	455	455	455	455	455
Cell Label		1	2	3	4	5A	5B	Total Outflow
Downstream Cell Label		3	4	Outflow	Outflow	5B	Outflow	-
Surface Area	km2	6.030	3.808	2.833	1.012	2.274	9.279	25.2
Mean Water Load	cm/d	2.7	4.3	8.3	16.7	14.4	3.5	2.6
Max Water Load	cm/d	17.1	27.1	32.4	103.8	90.7	22.2	16.3
Inflow Volume	hm3/yr	60.0	60.0	85.9	61.8	119.9	118.3	239.9
Inflow Load	kg/yr	8835.0	8835.0	4171.8	4319.3	17669.9	13278.2	35339.9
Inflow Conc	ppb	147.3	147.3	48.6	69.8	147.3	112.3	147.3
Treated Outflow Volume	hm3/yr	85.9	61.8	93.1	62.1	118.3	113.2	268.3
Treated Outflow Load	kg/yr	4171.8	4319.3	3266.9	2872.4	13278.2	4112.6	10251.8
Treated FWM Outflow Conc	ppb	48.6	69.8	35.1	46.3	112.3	36.3	38.2
Total FWM Outflow Conc	ppb	48.6	69.8	35.1	46.3	112.3	36.3	38.2
Surface Outflow Load Reduc	%	52.8%	51.1%	21.7%	33.5%	24.9%	69.0%	71.0%
Outflow Geometric Mean - Daily	ppb	39.3	58.7	30.7	27.2	98.2	17.8	28.1
Outflow Geo Mean - Composites	ppb	39.8	57.2	30.9	27.5	97.3	18.1	28.1
Frequency Outflow Conc > 10 ppb	%	100%	#DIV/0!	100%	#DIV/0!	#DIV/0!	#DIV/0!	100%

A summary comparison of the overall outflows from those runs to those computed with the DMSTA model is presented in Table 2.32.

Table 2.32 Comparison of Measured to Predicted Outflows, STA-1W 01/01/31-03/31/02

Parameter	Units	Measured Outflows	Predicted Outflows	
			With SAV_C4	With NEWS
Volume	Ac-ft	270,165	271,006	271,006
TP Load	Kg	12,286	9,832	12,771
Flow-Weighted (F.W.) Mean TP Conc.	ppb	36.9	29.4	38.2
Geo. Mean TP Conc. In Outflows				
Daily	ppb	30.9	27.0	28.1
7-day F.W. Means	ppb	31.0	26.7	28.1

As indicated in Table 2.32, the predicted outflow volume over the period closely approximates (within 0.3%) the measured outflow volumes, suggesting that the model adequately represents overall seepage inflow volumes to the STA. A cumulative plot of the measured and predicted outflow volumes over the 15-month period is presented in Figure 2.7. While the predicted overall discharge volume closely approximates the measured volume, it can be seen from that figure that significant variations do occur on more finite time steps. Those variations are believed to result from a combination of the following factors:

- The DMSTA model cannot accommodate a varying control elevation for seepage transfer. Changes in the stage in WCA-1 as would be suggested by its regulation schedule cannot be reflected in the analysis.
- The District's Operation Plan for STA-1W contemplates the establishment of seasonally varying control elevations in the various cells, which cannot be accommodated in the DMSTA model.
- Perhaps most significantly (both with respect to daily variations between measured and predicted daily outflows, and potentially to phosphorus removal performance), the operation of the outflow control structures and pumping stations does not closely approximate the operation implicitly assumed by the DMSTA model.

A plot of the measured and predicted daily outflow volumes over the 15-month period is presented in Figure 2.8. Simple inspection of that figure reveals that:

- Measured peak discharge rates markedly exceed those predicted in the DMSTA analysis.
- There exists a significant number of days with no measured discharge at the outflow pumping stations, while outflow would have been predicted in the DMSTA analysis.

Table 2.33 summarizes certain basic statistics relative to inflow and total discharge rates at STA-1W during the 15-month period from January 1, 2001 through March 31, 2002.

Table 2.33 Summary of Measured vs. Predicted Discharge Rates and Durations, STA-1W

Description	**Units**	**Inflow (G-302)**	**Outflow (Measured)**	**Outflow (Predicted)**
Peak Daily Discharge	cfs	2,476	3,177	2,221
Days with Discharge > 0	No.	208	171	455
Ave. Rate on Days with Discharge	cfs	587	796	300
Min. Rate on Days with Discharge	cfs	37*	10	19

*Excluding reported discharge of 0.9 cfs on 07/03/01

Of the total inflows at G-302, 49.9% were delivered to Cell 5, with inflows to Cell 1 and Cell 2 roughly equal (36,019 cfs-days to Cell 1, 35,940 cfs-days to Cell 2). The summation of inflows to Cells 1, 2 and 5 exceed total inflows at G-302 by 21,515 acre-feet (8.9%) over the 15-month period; that excess inflow confirms the presence of substantial seepage return to Cells 1 and 2 at G-250S. In addition, the data confirms the assigned distribution of inflows from G-302 to the various flow paths of STA-1W (50% to Cell 5A, and 25% each to Cells 1 and 2).

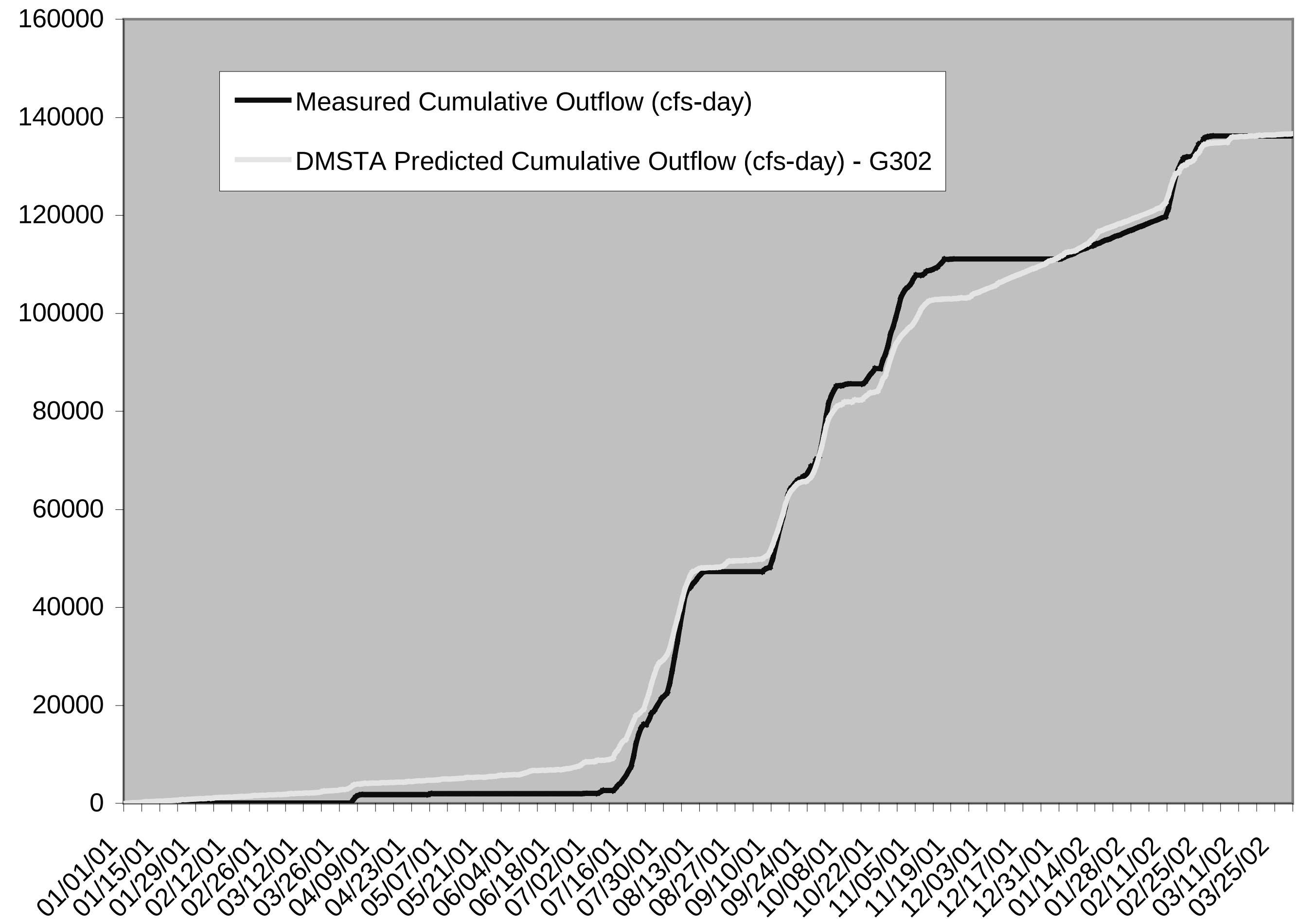


Figure 2.7 Measured vs. Predicted Cumulative Outflow, STA-1W 01/01/01-03/31/02

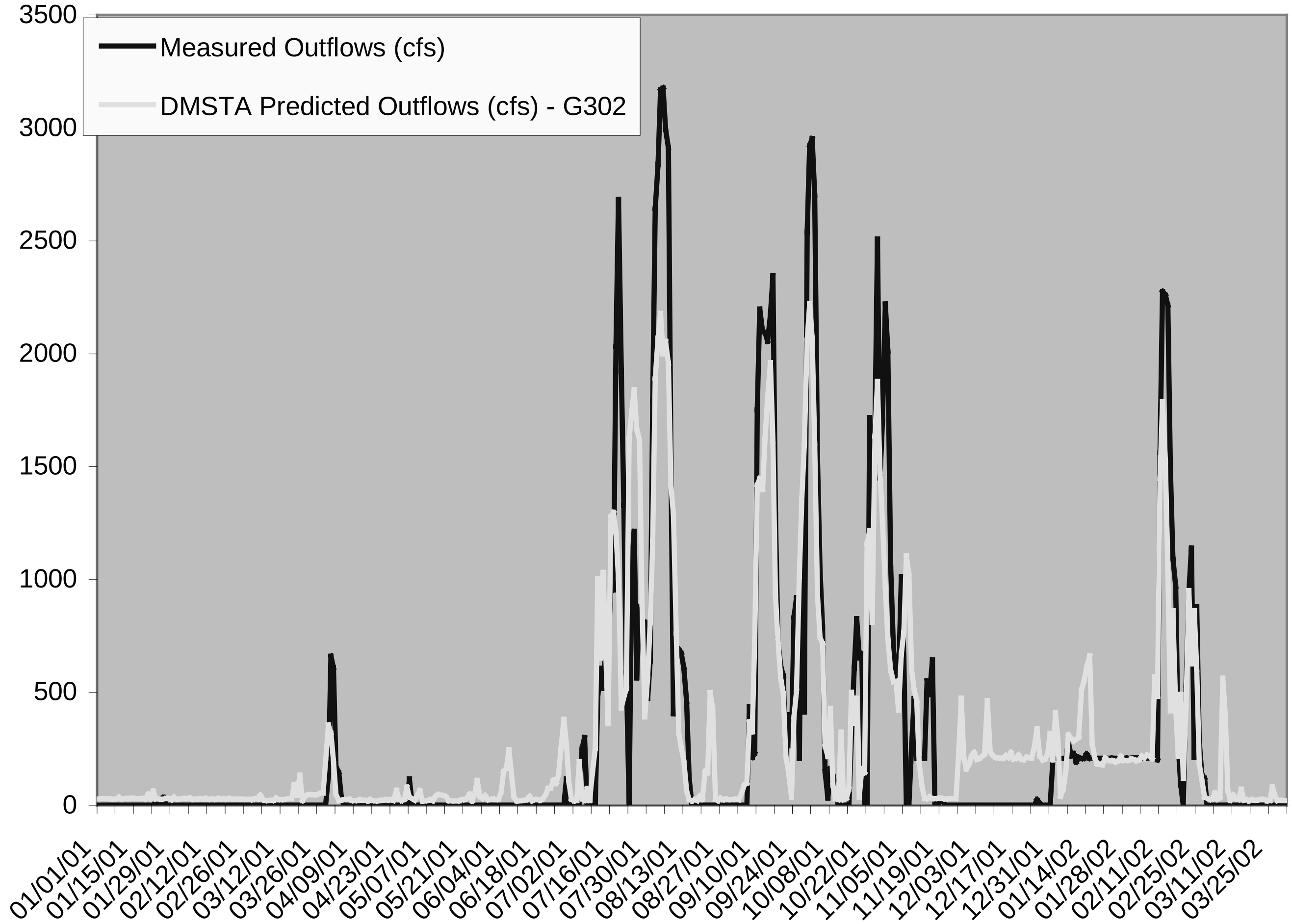


Figure 2.8 Measured vs. Predicted Daily Outflow, STA-1W 01/01/01-03/31/02

As discussed earlier in this Part 2, the modeled configuration of STA-1W excludes 326 acres of Cell 3 downstream of G-308, and 108 acres of Cell 4 downstream of G-309, on the assumption that little of the discharge from those cells is maintained within the treatment area and carried to Pumping Station G-251. During the 15-month period analyzed, a total of 120,865 acre-feet were introduced to Cells 5A and 5B. As modeled, there would be no external seepage inflow to those cells. The remaining G-302 inflows of 121,214 acre-feet, plus the estimated total seepage inflow of 33,839 acre-feet, are assigned to Cells 1-4. The total hydraulic load (surface plus seepage) to Cells 1-4 is then estimated to have been approximately 155,053 acre-feet. Net ET (total ET minus rainfall) on Cells 1-4 over the 15-month period was approximately 3,290 acre-feet, suggesting that the total discharge volume from Cells 1-4 was approximately 151,763 acre-feet. Total discharges at G-251 over the period were 8,434 acre-feet, suggesting that up to 143,329 acre-feet (94.4% of the total estimated outflow from Cells 1-4) were released to the discharge canal at G-308 and G-309, confirming that cell areas downstream of those structures contributed little to overall treatment performance.

A cumulative plot of the measured and predicted outflow TP loads over the 15-month period is presented in Figure 2.6. Predicted TP load discharge estimates were prepared considering Cells 4 and 5B as SAV_C4, and as NEWS. As indicated in Figure 2.9, use of NEWS slightly over predicts (by 3.9%) the measured outflow load and flow-weighted mean TP concentration, while the use of SAV_C4 substantially under predicts (by 20%) the measured outflow load and flow-weighted TP concentration. It is also interesting to note from the information presented earlier that, were Cell 4 analyzed as SAV_C4 and Cell 5B as NEWS, the predicted outflow TP load over the 15-month period would be 12,086 kilograms, within 1.6% of the measured outflow load of 12,286 kilograms. Those differences in predicted performance underscore the need for focused efforts on replicating the performance of Cell 4 (on which the SAV_C4 treatment parameters are based) in other, larger cells.

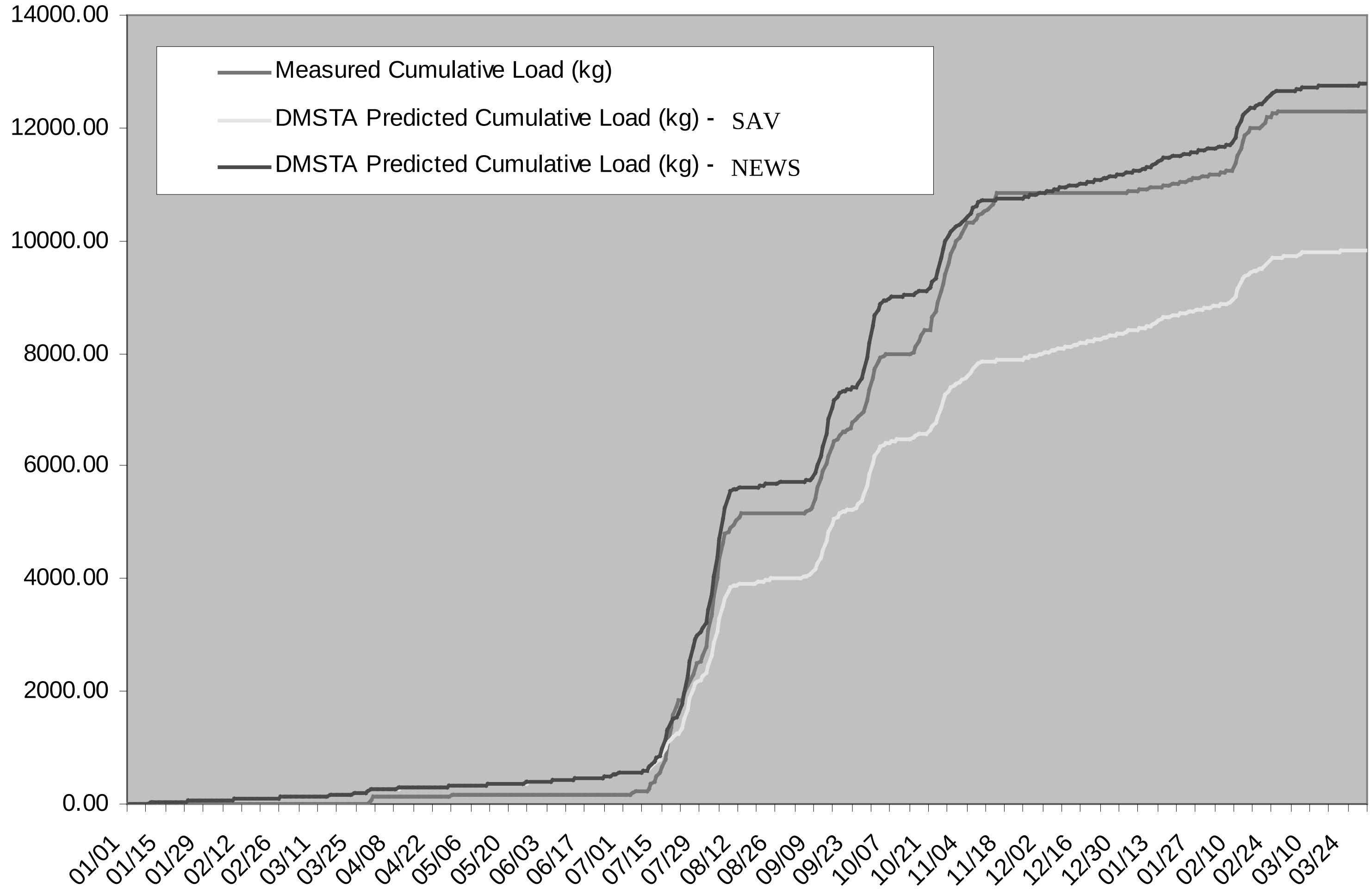


Figure 2.9 Measured vs. Predicted Cumulative Outflow Loads, STA-1W 01/01/01-03/31/02

It is included from this verification analysis that the DMSTA model of STA-1W given its current configuration adequately addresses the hydrologic performance of the treatment area, and that additional improvement in treatment performance (primarily in Cell 5B) is needed to fulfill expectations for use of the SAV_C4 treatment performance parameters.

This verification analysis also suggests that additional improvement in the current performance of STA-1W might be realized by modifying current operational practices relative to outflow control.

Over the 15-month period, Pumping Station G-251 was operated on a total of 54 days. The maximum daily discharge from this 450-cfs facility was 195 cfs; the average discharge on days the station was operated was 79 cfs. It is not known from the data furnished if discharges were made through G-259 during the period. On only 14 days was G-251 operated when there was not a concurrent operation of G-310.

Figure 8 in the January, 2001 *Operation Plan, Stormwater Treatment Area 1 West* suggests that all discharges from Cells 3 and 4 up to a combined rate of 363 cfs should be discharged through Pumping Station G-251. However, that figure does not indicate the potential influence of upwelling seepage on the hydraulic profile through the treatment area (i.e., the combined inflows to Cells 1 and 2 are also shown as 363 cfs). Considering the measured inflows to Cells 1 and 2 combined, and assigning all inflow rates of 300 cfs and below as being ultimately discharged at G-251, slightly over 70% of the total inflow to Cells 1 and 2 could have been passed entirely through Cells 2 and 4 to G-251, as compared to the measured 6%. It would appear possible to recover some substantial part of the 434 acres of STA-1W presently considered as ineffective through modified operations at G-251.

Pumping Station G-310 was operated on a total of 157 days over the 15-month period. The average daily discharge from that station when operating was 840 cfs, as compared to a mean inflow rate (at G-302) of 587 cfs when operating (overall mean of 268 cfs) and an overall mean outflow rate from STA-1W of 299 cfs. It appears that the operation of G-310 could be modified to markedly reduce the influence of pulsed flow on outflows.

2.7 STA-1W Alternative No. 1

Under Alternative No. 1, STA-1W would be modified to improve its performance, with completion of all modifications and placement into service of the modified treatment area occurring prior to 2007. For this analysis, that improvement is considered to consist of the conversion of Cell 3 from emergent vegetation to Submerged Aquatic Vegetation (SAV_C4).

A schematic of STA-1W under Alternative 1, is presented in Figure 2.10.

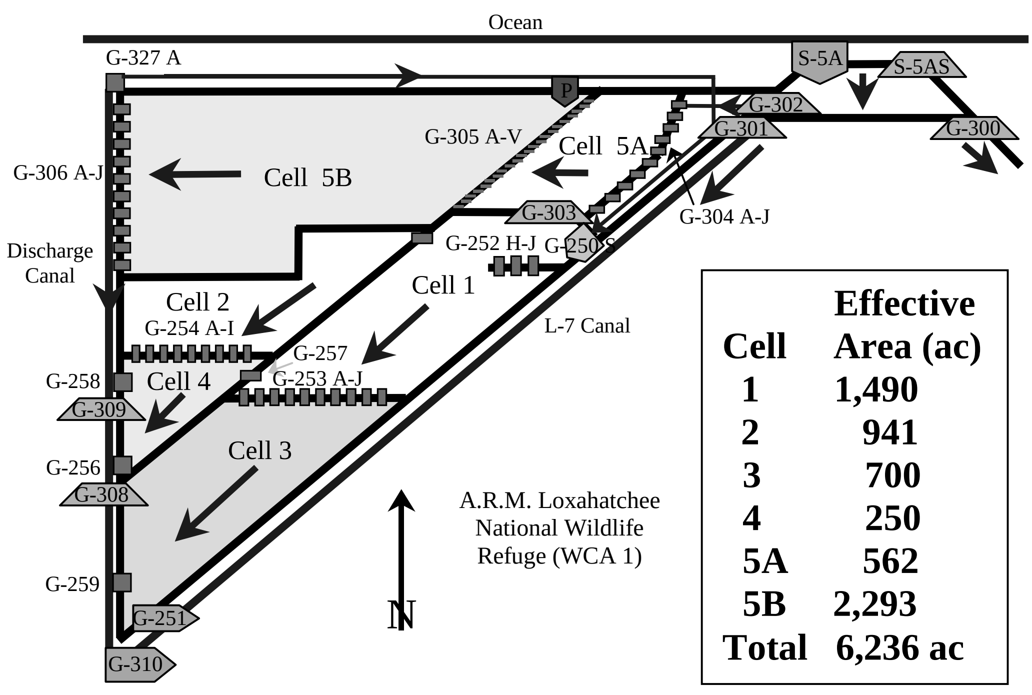


Figure 2.10. Schematic of STA-1W under Alternative 1

2.7.1 Treatment Analysis Input Data Summary

Inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 1 are taken from the "sta1w inflow tp.xls" Excel file. Inflow volumes and TP loads are identical to those summarized in Table 2.24 Estimated Inflows, STA-1W Existing Analysis, 1965-1995. Inflow rates, TP concentrations, rainfall, and evapotranspiration employed in the DMSTA analysis of Alternative 1 were taken from this file and these input variables are defined in the Excel worksheet "1W Alternative 1" included in workbook "1W_Alt1_Data.xls".

2.7.2 Summary of Input Variables for Treatment Analysis

Other than as discussed below, input variables employed in the analysis of Alternative 1 for STA-1W are identical to those included in the Baseline 2007-2056 Condition analysis.

- The Outflow Control Depth in Cell 3 was modified from 40 cm to 60 cm.
- The vegetation type in Cell 3 was revised from "Emergent" to "SAV_C4", and the associated default treatment parameters of DMSTA were employed in the analysis.

2.7.3 Results of DMSTA Analysis for Alternative 1

A detailed listing of input variables employed in the analysis of Alternative 1 for STA-1W, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 2.34 (which consists of screen information taken directly from the DMSTA output file).

Table 2.34 Results of DMSTA Analysis, STA-1W, Alternative 1

Case Description: **Filename:** **1W_Alt1_Data.xls**

Existing, Cells 1,2 & 5A--Emergent & Cell 3,4 & 5B--SAV_C4
Alternative 1

Input Variable	Units	Value
Design Case Name	-	1W Alternative1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.1%
Flow-Wtd Conc - With Bypass	ppb	18.7
Flow-Wtd Conc - Without Bypass	ppb	18.7
Geometric Mean Conc	ppb	13.6
95th Percentile Conc	ppb	22.6
Freq Cell Outflow > 10 ppb	%	45%
Bypass Load	%	0.0%

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**
Cell Label	-	1	2	3	4	5A	5B
Vegetation Type	------->	EMERG	EMERG	SAV_C4	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.25	0.25	0	0	0.5	0
Downstream Cell Number	-	3	4	0	0	6	0
Surface Area	km2	6.030	3.808	2.833	1.012	2.274	9.279
Mean Width of Flow Path	km	1.10	1.74	2.48	1.83	1.78	2.34
Number of Tanks in Series	-	2	2	2	2	2	3
Outflow Control Depth	cm	55	67	46	60	60	60
Outflow Coefficient - Exponent	-	2.35	2.51	2.5	2.5	2.49	2.25
Outflow Coefficient - Intercept	-	1.24	1.38	1.03	1.28	2.75	3.78
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.01038	0.00547	0.00676	0.00485	0	0
Inflow Seepage Control Elev	cm	183	101	163	82	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.00346	0	0.00173	0	0.01577	0.00496
Outflow Seepage Control Elev	cm	43	0	40	0	-46	-46
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0	0	0	0	0.91	0.8
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*80.10*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	0.77	1.48	2.23	2.94	3.65	4.68	4.68
Run Date	-	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1	2	3	4	5A	5B	Total Outflow
Downstream Cell Label		3	4	Outflow	Outflow	5B	Outflow	-
Surface Area	km2	6.030	3.808	2.833	1.012	2.274	9.279	25.2
Mean Water Load	cm/d	2.2	3.6	7.4	14.1	11.9	2.9	2.1
Max Water Load	cm/d	12.9	20.5	31.5	89.5	68.6	17.8	12.4
Inflow Volume	hm3/yr	49.5	49.5	77.1	52.2	99.0	97.8	197.9
Inflow Load	kg/yr	6854.8	6854.8	3322.8	3258.3	13709.6	9597.4	27419.3
Inflow Conc	ppb	138.5	138.5	43.1	62.4	138.5	98.1	138.5
Treated Outflow Volume	hm3/yr	77.1	52.2	85.0	52.6	97.8	94.6	232.2
Treated Outflow Load	kg/yr	3322.8	3258.3	1324.8	1599.5	9597.4	1428.0	4352.3
Treated FWM Outflow Conc	ppb	43.1	62.4	15.6	30.4	98.1	15.1	18.7
Total FWM Outflow Conc	ppb	43.1	62.4	15.6	30.4	98.1	15.1	18.7
Surface Outflow Load Reduc	%	51.5%	52.5%	60.1%	50.9%	30.0%	85.1%	84.1%
Outflow Geometric Mean - Daily	ppb	39.3	55.6	12.8	21.8	89.4	8.8	13.0
Outflow Geo Mean - Composites	ppb	39.7	56.2	13.1	22.8	91.4	9.3	13.6
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	100%	100%	86%

A condensed summary of the results of the analysis is presented in Table 2.35, which is considered reflective of the long-term treatment performance of STA-1W following full implementation of Alternative 1.

Table 2.35 Discharge Summary, STA-1W, Alternative 1

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	232
Average Annual Outflow Volume	Ac-ft/yr	188,100
Average Annual Outflow TP Load	Kg/yr	4,352.3
Flow-weighted Mean TP Concentration	ppb	19
Geometric Mean TP Concentration, weekly composites	ppb	14

2.8 STA-1W Alternative No. 2

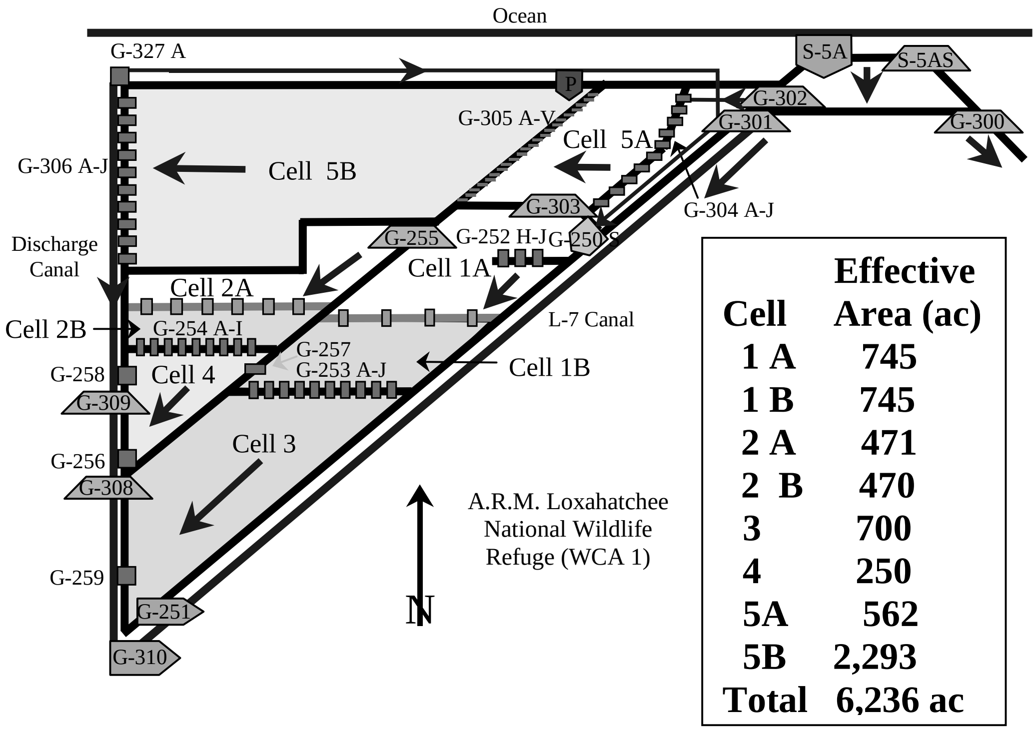
Under Alternative No. 2, STA-1W would be further optimized through:

- Conversion of a part of both Cell 1 and Cell 2 to SAV
- Increased compartmentalization
- Improved flow distribution

A schematic of STA-1W under Alternative 1, is presented in Figure 2.10.

2.8.1 Treatment Analysis Input Data Summary

Inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 2 are taken from the “sta1w inflow tp.xls” Excel file. TP loads are identical to those summarized in Table 2.24 Estimated Inflows, STA-1W Existing Analysis, 1965-1995. Inflow fractions were redistributed according to outflow TP concentrations in each parallel flow path until a geometric mean of 10 ppb for the STA was reached. Inflow rates, TP concentrations, rainfall, and evapotranspiration employed in the DMSTA analysis of Alternative 2 are defined in the Excel worksheet "1W Alternative 2" included in workbook "1W_Alt2_Data.xls".



Cell	Effective Area (ac)
1 A	745
1 B	745
2 A	471
2 B	470
3	700
4	250
5A	562
5B	2,293
Total	6,236 ac

Figure 2.11. Schematic of STA-1W under Alternative 2

2.8.2 Summary of Input Variables for Treatment Analysis

The following additional modifications were made in the input parameters for Alternative 2 (Cell 3 was considered as converted to SAV_C4 as was done for Alternative 1):

- Cell 1 was split into Cell 1A and 1B. It was considered that a new transverse levee and control structures would be constructed separating the two cells.
  - The split reduced the effective treatment area of emergent vegetation in Cell 1 from 1,490 acres to 745 acres (Cell 1A).

   - Likewise, the effective treatment area of SAV vegetation was increased with the addition of Cell 1B (745 acres).

- Cell 2 was split into Cell 2A and 2B. It was considered that a new transverse levee and control structures would be constructed in connection with that conversion.
   - The split reduced the effective treatment area of emergent vegetation in Cell 2 from 941 acres to 471 acres (Cell 2A).
   - Likewise, the effective treatment area of SAV vegetation was increased with the addition of Cell 2B (470 acres).
- The number of CSTRs increased in the cells with SAV increased due to additional compartmentalization.
- The distribution of inflows from G-302 was modified.
   - The inflow fraction to Cell 5A was reduced from 0.50 to 0.41.
   - The inflow fraction to Cell 1 was increased from 0.25 to 0.39.
   - The inflow fraction to Cell 2 was reduced from 0.25 to 0.20.

2.8.3 Results of DMSTA Analysis for Alternative 2

A detailed listing of input variables employed in the analysis of Alternative 2 for STA-1W, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 2.36 (which consists of screen information taken directly from the DMSTA output file).

Table 2.36 Results of DMSTA Analysis, STA-1W Existing Design, Alternative 2

Case Description: Existing, Cells 1,2 & 5A--Emergent & Cell 3,4 & 5B--SAV_C4; Alternative 2; Redistributed inflows -- Balanced Outflow Concentrations; Reduction of Cell 1 Area, Increase Cell 3 Area

Filename: 1W_Alt3_Data.xls

Input Variable	Units	Value
Design Case Name	-	1W Alternative 2
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.1%
Flow-Wtd Conc - With Bypass	ppb	13.3
Flow-Wtd Conc - Without Bypass	ppb	13.3
Geometric Mean Conc	ppb	9.3
95th Percentile Conc	ppb	16.9
Freq Cell Outflow > 10 ppb	%	41%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4	5A	5B
Vegetation Type	------->	EMERG	EMERG	SAV_C4	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.39	0.2	0	0	0.41	0
Downstream Cell Number	-	3	4	0	0	6	0
Surface Area	km2	3.015	1.906	5.850	2.914	2.274	9.279
Mean Width of Flow Path	km	1.10	1.74	2.48	1.83	1.78	2.34
Number of Tanks in Series	-	2	2	4	6	2	3
Outflow Control Depth	cm	55	67	46	60	60	60
Outflow Coefficient - Exponent	-	2.35	2.51	2.5	2.5	2.49	2.25
Outflow Coefficient - Intercept	-	1.24	1.38	1.03	1.28	2.75	3.78
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.01038	0.00547	0.00676	0.00485	0	0
Inflow Seepage Control Elev	cm	183	101	163	82	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.00346	0	0.00173	0	0.01577	0.00496
Outflow Seepage Control Elev	cm	43	0	40	0	-46	-46
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0	0	0	0	0.91	0.8
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*80.10*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	0.81	1.55	2.87	4.84	5.55	6.58	6.58
Run Date	-	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02	07/05/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1	2	3	4	5A	5B	Total Outflow
Downstream Cell Label		3	4	Outflow	Outflow	5B	Outflow	-
Surface Area	km2	3.015	1.906	5.85	2.914	2.274	9.279	25.2
Mean Water Load	cm/d	7.0	5.7	4.2	3.8	9.8	2.4	2.1
Max Water Load	cm/d	40.4	32.8	22.4	23.3	56.3	14.5	12.4
Inflow Volume	hm3/yr	77.2	39.6	90.6	41.0	81.2	80.0	197.9
Inflow Load	kg/yr	10693.5	5483.9	7379.5	3254.4	11241.9	7379.8	27419.3
Inflow Conc	ppb	138.5	138.5	81.4	79.5	138.5	92.3	138.5
Treated Outflow Volume	hm3/yr	90.6	41.0	106.7	42.2	80.0	76.8	225.7
Treated Outflow Load	kg/yr	7379.5	3254.4	1410.3	554.0	7379.8	1027.2	2991.5
Treated FWM Outflow Conc	ppb	81.4	79.5	13.2	13.1	92.3	13.4	13.3
Total FWM Outflow Conc	ppb	81.4	79.5	13.2	13.1	92.3	13.4	13.3
Surface Outflow Load Reduc	%	31.0%	40.7%	80.9%	83.0%	34.4%	86.1%	89.1%
Outflow Geometric Mean - Daily	ppb	75.2	71.9	9.8	7.3	83.7	7.7	9.2
Outflow Geo Mean - Composites	ppb	76.1	72.7	10.1	7.5	85.6	8.0	9.3
Frequency Outflow Conc > 10 ppb	%	100%	100%	49%	35%	100%	41%	33%

A condensed summary of the results of the analysis is presented in Table 2.37.

Table 2.37 Discharge Summary, STA-1W, Alternative 2

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	226
Average Annual Outflow Volume	Ac-ft/yr	183,300
Average Annual Outflow TP Load	Kg/yr	3,148.9*
Flow-weighted Mean TP Concentration	ppb	14*
Geometric Mean TP Concentration, weekly composites	ppb	10**

*Computed F.W.M. Less than the LSC assigned as 14 ppb.
**Computed GeoMean Conc. Less than LSC assigned as 10 ppb.

2.9 Probable Cost

2.9.1 Opinion of Probable Capital Costs

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 1:

- Construction of a small seepage pumping station near the northeast corner of Cell 5A, included in the design to permit withdrawal from the seepage canal to maintain stages in the downstream SAV Cell 5B. The station is assigned a preliminary capacity of 65 cfs (equal to a maximum daily evaporation rate of 0.24"/day in Cell 5A and 5B, and an estimated seepage loss from the cell of 0.30"/day).
- Herbicide treatment of Cell 3 for removal of emergent macrophyte vegetation to permit development of SAV_C4. That treatment was considered as applicable to the entire 1,026-acre nominal area of Cell 3, despite limiting the effective are to 700 acres in the analysis.

It is anticipated that sufficient seepage inflows will be induced from the refuge to maintain the entire STA in a hydrated condition.

An opinion of the probable capital cost for Alternatives 1 is presented in Table 2.38.

Table 2.38 Opinion of Probable Capital Cost, STA-1W Alternatives 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Pumping Station, Cell 5A	65	cfs	$9,900	$643,500	Unit cost from Evaluation Methodology
2	Eradication of Existing Vegetation	1,026	ac	$200	$205,200	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$848,700**	**$850,000**
Planning, Engineering & Design		10 %			$84,870	**$85,000**
Program & Construction Management		10 %			$84,870	**$85,000**
Total Estimated Cost, Without Contingency					**$1,018,440**	**$1,020,000**
Contingency		30 %			$305,532	**$300,000**
TOTAL ESTIMATED CAPITAL COST					**$1,323,972**	**$1,320,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 2:

- All physical works previously identified for Alternative 1.
- Herbicide treatment in those parts of Cells 1 and 2 to be converted to SAV.
- Replacement of existing Structure G-255 with a fully operable control structure (nominal capacity of approximately 585 cfs). It will also be necessary to extend power from G-303 to the new structure.
- Construction of a new levee across Cell 2, together with a series of culverts for improved flow distribution. Those structures are anticipated to consist of corrugated metal culverts with stop log risers (total of six 84” culverts).
- Construction of a new levee across Cell 1, together with a series of fully operable control structures. The nominal combined capacity of those structures would be 1,105 cfs; they are expected to consist of the hydraulic equivalent of four gated 8’x8’ RCBs. The construction of a new power line would be required for those structures.

An opinion of the probable capital cost for Alternative 2 is presented in Table 2.39.

Table 2.39 Opinion of Probable Capital Cost, STA-1W Alternative 2

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee in Cell 2, 7' height (Excludes Blasting Costs)	1.2	Mi.	$390,000	$468,000	Unit cost from Evaluation Methodology
2	New Internal Levee in Cell 1, 7' height (Excludes Blasting Costs)	1	Mi.	$390,000	$390,000	Unit cost from Evaluation Methodology
3	Blasting for New Levee and Canals	2.2	Mi.	$48,000	$105,600	Allow Approx.$1/cy
4	New Water Control Structures in Cell 1 (8'x8' similar to G-381, Gated)	4	Ea.	$190,000	$760,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
5	New Water Control Structures in Cell 2	6	Ea.	$35,000	$210,000	Unit cost from Evaluation Methodology
6	Replacement Structure G-255	1	Ea.	Allow	$380,000	Roughly equivalent to two 8'x8' RCBs
7	Water Control Structure Electrical (Includes Telemetry)	5	Ea.	$43,000	$215,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
8	Stilling Wells (Includes Electrical and Telemetry)	4	Ea.	$9,000	$36,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
9	Electrical Power Distribution	3.2	Mi.	$80,000	$256,000	Unit cost from Evaluation Methodology
10	Pumping Station, Cell 5A	65	cfs	$9,900	$643,500	Unit cost from Evaluation Methodology
11	Eradication of Existing Vegetation	2241	ac	$200	$448,200	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$3,912,300**	**3,900,000**
Planning, Engineering & Design		10 %			$391,230	**400,000**
Program & Construction Management		10 %			$391,230	**400,000**
Total Estimated Cost, Without Contingency					**$4,694,760**	**4,700,000**
Contingency		30 %			$1,408,428	**1,400,000**
TOTAL ESTIMATED CAPITAL COST					**$6,103,188**	**6,100,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

2.9.2 Opinion of Probable Annual Costs for Operation & Maintenance

The following is a summary listing of the anticipated incremental operation and maintenance requirements for Alternative 1 (e.g., requirements in addition to those for operation of maintenance of STA-1W as presently designed):

- Operation and maintenance of a small forward-pumping station at Cell 5A. The pumps in this station are assumed driven by electric motors. The pump station operating costs are estimated using a power cost of $0.08/kw-hr; an assumed total head of 6 feet; an overall efficiency of 85%; and an assigned utilization equal to 10% of the overall time. The resultant power consumption is 0.43 kw/cfs, or 3,770 kw-hr/cfs/yr, which yields an approximate average annual cost of $300/yr/cfs.

- Additional herbicide treatment of Cell 3 for control of invasive species and emergent macrophyte vegetation. This item includes both:
  - Annual costs to spray for invasive species.
  - Additional costs for post-drought eradication of undesirable species.

The February 22, 2002 Draft *Supplemental Technology Standard of Comparison (STSOC) Analysis for Submerged Aquatic Macrophyte/Limerock Technology*, D.B Environmental, presents an estimated cost of $25/acre/year for regular herbicide treatment for control of invasive species, and an additional $10/acre/year for post-drought eradication spraying. Given the inclusion of the forward-pumping station for maintenance of stages in the SAV cell, the opinion of probable incremental operation and maintenance cost includes a substantially reduced allowance of $10/acre/year for both those items.

An opinion of the probable incremental annual operation and maintenance cost for Alternative 1 is presented in Table 2.40.

Table 2.40 Opinion of Probable Incremental O&M Cost, STA-1W Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Mech. Maintenance, Pumping Station	1	Ea.	$10,000	$10,000	Unit cost from Evaluation Methodology
2	Power Consumption, Pumping Station	65	cfs	$300	$19,500	See text for basis of estimated unit cost
3	Incremental Cost forAnnual Vegetation Control	1026	ac	$10	$10,260	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$39,760**	
Contingency		30 %			$11,928	
TOTAL INCREMENTAL O&M COST					**$51,688**	**$50,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

Anticipated incremental operation and maintenance costs for Alternative 2 would include those described above for Alternative 1, as well as:

- Costs for maintenance of the additional levees and control structures.
- Additional costs for annual vegetation control associated with the incremental areas converted to SAV.

An opinion of the probable incremental annual operation and maintenance cost for Alternative 2 is presented in Table 2.41.

Table 2.41 Opinion of Probable Incremental O&M Cost, STA-1W Alternative 2

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levees	2.2	Mi.	$1,530	$3,366	Unit cost from Evaluation Methodology
2	New Water Control Structures	5	Ea.	$12,000	$60,000	Unit cost from Evaluation Methodology
3	Mech. Maintenance, Pumping Station, Cell 5A, 2 units assumed	2	Ea.	$10,000	$20,000	Unit cost from Evaluation Methodology
4	Power Consumption, Pumping Station, Cell 5A	65	cfs	$300	$19,500	See text for basis of estimated unit cost
5	Incremental Cost forAnnual Vegetation Control	2241	ac	$10	$22,410	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$125,276**	
Contingency		30 %			$37,583	
TOTAL INCREMENTAL O&M COST					**$162,859**	**$165,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

2.9.3Total Present Worth

The total present cost of Alternatives 1 & 2 is presented in Tables 2.42 and 2.43, and is computed as of December 31, 2006. They are based on a 50-year project life (period of analysis), a discount rate of 6-3/8% and annual escalation of 3%.

Table 2.42 Total Present Worth, STA-1W Alternative 1

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present**
Year		**PED**	**P&CM**	**Const.**	**Total**	**Worth**
2004		$90,177			$90,177	$79,692
2005			$92,882	$1,256,636	$1,349,518	$1,121,140
Total Capital Cost					$1,439,694	$1,200,832
Incremental Costs for Operation and Maintenance						**Present**
From	**To**			**Total O&M Cost**		**Worth**
2007	2056				$6,538,124	1,031,187
Total Present Worth of Alternative						**$2,232,020**

Table 2.43 Total Present Worth, STA-1W Alternative 2

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present**
Year		**PED**	**P&CM**	**Const.**	**Total**	**Worth**
2003		$412,000			$412,000	$387,309
2004			$212,180	$2,811,385	$3,023,565	$2,672,023
2005			$218,545	$2,895,727	$3,114,272	$2,587,247
Total Capital Cost					$6,549,837	$5,646,578
Incremental Costs for Operation and Maintenance						**Present**
From	**To**			**Total O&M Cost**		**Worth**
2007	2056				$21,575,810	3,402,919
Total Present Worth of Alternative						**$9,049,497**

2.10 Summary of Evaluation Criteria Scoring

The following tables present summaries of the evaluation criteria scoring for the alternative water quality improvement strategies for STA-1W. The information presented therein will subsequently be employed by the District and others in further evaluation of the alternatives, and identification of that alternative or alternative(s) to be carried forward to the conceptual design phase.

Table 2.44 Summary Evaluation Criteria Scores, STA-1W Alternative 1

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline 1W	tonnes	283	Table 2.27
		50-Year TP Load Disc. - Alternative 1	tonnes	218	Table 2.35
		Phosphorus Load Reduction	%	23.0	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	19	Table 2.35
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	14	Table 2.35
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$2,232,020	Table 2.42
	2	Total 50-Year TP Removal	kg	65,060	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$34.31	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)

- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002
- Discount Rate of 6-3/8%

Table 2.45 Summary Evaluation Criteria Scores, STA-1W Alternative 2

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline 1W	tonnes	283	Table 2.27
		50-Year TP Load Disc. - Alternative 2*	tonnes	157	Table 2.37*
		Phosphorus Load Reduction	%	44.3	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	14*	Table 2.37
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10**	Table 2.37
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$9,049,497	Table 2.43
	2	Total 50-Year TP Removal	kg	125,230	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$72.26	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002
- Discount Rate of 6-3/8%

* Computed F.W.M. Conc. Less than LSC assigned as 14 ppb.
** Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

2.11 Sensitivity Analyses of Phosphorus Reduction Parameters

The effectiveness of phosphorus reduction in the alternatives considered are examined with respect to the change in the following three input parameters presented in the sensitivity analyses:

- Varying BMP Performance
- Different SAV Communities
- All Input Parameters
  - Uncertainty Analysis

The third analysis (all input parameters) also employs an uncertainty analysis. The information presented therein will assist the District in further analyses of the alternatives presented in the future evaluation of the parameters.

2.11.1 Variation in BMP Performance

The alternatives performed in the BMP sensitivity analysis for STA-1W involved the following variations in inflow loads:

- Normal Analysis (existing conditions – no reductions necessary)
  - S-5A Basin – 50% reduction in TP loads
  - WPB Canal BMP MUW – 0% reduction in TP loads
  - L.O. Water Supply – 0% reduction in TP loads
- Sensitivity Analysis #1
  - S-5A Basin – 25% reduction in TP loads
  - WPB Canal BMP MUW – 0% reduction in TP loads
  - L.O. Water Supply – 0% reduction in TP loads
- Sensitivity Analysis #2
  - S-5A Basin – 75% reduction in TP loads
  - WPB Canal BMP MUW – 0% reduction in TP loads

- L.O. Water Supply – 0% reduction in TP loads

Table 2.46 Variation in BMP Performance

Condition	Location	TP Conc. For BMP Load Reduction					
		Normal		Sens. #1		Sens. #2	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
Baseline, Existing	STA-1W Inflows	139	--	199	--	78	--
	STA-1W Outflows	24	24	30	31	18	17
Alternative1	STA-1W Inflows	139	--	199	--	78	--
	STA-1W Outflows	19	14	23	17	14*	10**
Alternative 2	STA-1W Inflows	139	--	199	--	78	--
	STA-1W Outflows	14*	10**	15	11	14*	10**

*Computed F.W.M. Less than the LSC assigned as 14 ppb.
**Computed GeoMean Conc. Less than LSC assigned as 10 ppb.

2.11.2 Variation in SAV Performance

The current vegetative community (SAV_C4) was changed to the non-emergent wetland system vegetative community (NEWS) to determine the effects of different vegetative communities on the phosphorus reduction parameters. Table 2.47 summarizes, for the baseline condition, Alternative 1, and Alternative 2, the outcome of the phosphorus reduction performance due to different SAV communities.

Table 2.47 Variation in SAV Performance

Condition	Location	TP Conc. For Different SAV Communities			
		SAV_C4		NEWS	
		F.W.	Geo.	F.W.	Geo.
Baseline	STA-1W Inflows	139	--	139	--
	STA-1W Outflows	24	24	30	26
Alternative 1	STA-1W Inflows	139	--	139	--
	STA-1W Outflows	19	14	27	16
Alternative 2	STA-1W Inflows	139	--	139	--
	STA-1W Outflows	14*	10**	22	13

*Computed F.W.M. Less than the LSC assigned as 14 ppb.
**Computed GeoMean Conc. Less than LSC assigned as 10 ppb.

2.11.3 All Input Variables (DMSTA Sensitivity Model)

The sensitivity of the phosphorus reduction performance to all input variables available in the DMSTA model was tested through its built-in Sensitivity Model which also includes an Uncertainty Analysis module. The Sensitivity Model assesses the average percent change in these four output parameters for each input changed:

- Treated Flow-weighted Mean Outflow Concentration
- Total Flow-weighted Mean Outflow Concentration
- Outflow Geometric Mean – Composite
- Total Outflow Load

A Sensitivity Scale Factor of 25% (i.e. 25% change in each input) was used in all runs. Both high and low results were tested; in other words, two runs were conducted for each input variable, one at 75% and the other at 125% of the original value of the input variable under consideration. With approximately 25 different input variables, multiplied by the number of cells in the STA, and the high and low end of results tested, the Sensitivity Analysis included a potential of 180 or more DMSTA runs for each case.

No change in output from each run for each case exceeded 25%. The biggest changes in the four output variables, consistently across each case, was caused by the input variable, Inflow Fraction.

The DMSTA Model also includes an Uncertainty Analysis which lists the actual change of any one of the four above-listed output variables based on the "uncertainty" of the input variables. If one of the 23 variables (available in this analysis) under consideration is insensitive, then the range of values will not change significantly.

The DMSTA Uncertainty Analysis uses results from the above Sensitivity Model. The input into the model is the variable labeled "Error CV", which is the Standard Error divided by the Mean. The default input Error CV in the DMSTA model was utilized for the analyses. The outputs are the 10th, 50th, and 90th percentile estimate of the four listed output parameters.

Since the analysis of STA-1W includes no bypass analysis, the resultant Total Flow-weighted Mean Outflow Concentration is the same as the resultant Treated Flow-weighted Mean Outflow Concentration. Outputs from the four DMSTA cases are shown in Table 2.48:

Table 2.48 Uncertainty Analyses of All Input Variables

Condition	Location	TP Conc. For BMP Load Reduction in STA-1W								
		10th Percentile Est.			50th Percentile Est.			90th Percentile Est.		
		F.W.	Geo.	Load	F.W.	Geo.	Load	F.W.	Geo.	Load
Baseline, Existing	STA-1W Outflows	19	18	4,311	24	24	5,654	30	30	6,996
Alternative 1	STA-1W Outflows	14	10	3,293	19	14	4,352	23	17	5,412
Alternative 2	STA-1W Outflows	14*	10**	3,149*	14*	10**	3,149*	17	12	3,751

*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

The results show that there is a fairly wide range of uncertainty in phosphorus reduction performance, particularly in the baseline conditions.

Table of Contents

List of Tables

List of Figures

3. STORMWATER TREATMENT AREA NO. 2 (STA-2)

STA-2 provides a total effective treatment area of 6,340 acres, situated west the L-6 Borrow Canal and including lands from the former Brown's Farm Water Management Area, with Water Conservation Area 2A to its east, and three miles north of Pump Station S-7. This stormwater treatment area is intended to treat inflows from the Hills/West Palm Beach Canal (via Pumping Station S-6). Those inflows are comprised of contributions from a number of sources, including:

- Agricultural runoff and discharges from the S-2/S-6 Basin
  - Hills Canal
  - WPB Canal
- 298 Drainage District
- Supplemental (irrigation) water necessary to prevent dryout of the STA from Lake Okeechobee and BMP water
- Bypass Flows

STA-2 has three parallel flow paths, each with a southerly flow path. Cells 1 and 2 have emergent macrophytic vegetative communities and Cell 3 has submerged aquatic vegetation (SAV).

A schematic of the current design of STA-2 is presented in Figure 3.1.

3.1 Existing Conditions (Baseline 2007-2014)

An analysis of Existing Conditions was prepared to assess the probable performance of STA-2 under regional conditions existing upon completion of the Everglades Construction Project, but prior to completion of other major initiatives (such as the Comprehensive Everglades Restoration Plan, or CERP). That analysis was prepared for a thirty-one year period, extending from 1965 through 1995, using simulated inflow volumes from the District's South Florida Water Management Model (SFWMM) and inflow total phosphorus

(TP) loads developed as defined in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies.* The probable performance of STA-2 in reducing total phosphorus was evaluated through use of the DMSTA software, version dated April 12, 2002 (additional information on this software is presented in Part 1).

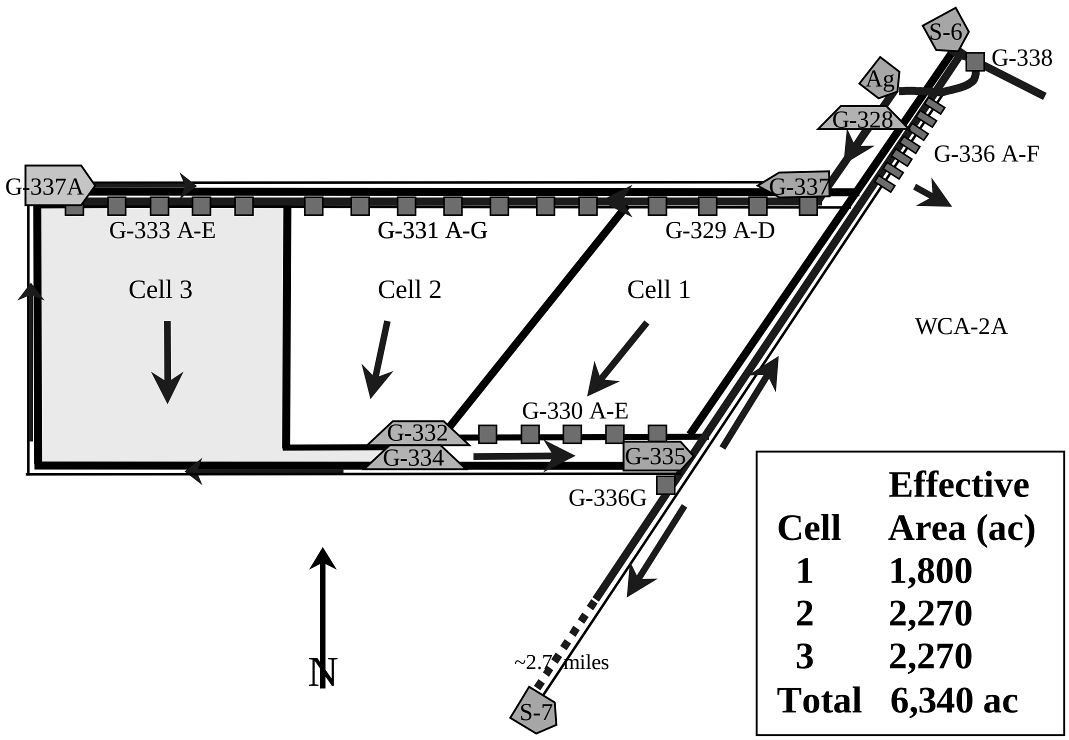


Figure 3.1. Schematic of STA-2

3.1.1 Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Existing Conditions for STA-2. Daily inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Existing Conditions are included in an Excel file "2EX_Data.xls".

Inflow Volumes and TP Loads: As presented in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies*, the estimated average annual inflows to STA-2 over the 31-year period are 233,474 acre-feet per year at a flow-weighted mean inflow concentration of 100 ppb (28.81 metric tons inflow TP per year).

Daily estimates of inflow by source were taken from an Excel spreadsheet prepared by the District in connection with preparation of the *Baseline Data* (file name "sta2 inflow tp.xls" dated May 11, 2001). Table 3.1 summarizes the estimated average annual inflow volumes and total phosphorus (TP) loads and concentrations to STA-2 represented in those daily estimates.

Table 3.1. Estimated Inflows, STA-2 Existing Analysis, 1965-1995

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
S-2/S-6 Basin			
Hills Canal	180,007	20.05	90
WPB Canal	42,611	6.28	120
Drainage District 298	9,247	2.35	206
BMP MUW Hills Canal	1,353	*	*
Water Supply	256	*	*
Combined STA2 BMP / Water Supply	1,609	0.15	74
Total Average Annual Inflows	**233,474**	**28.83**	**100**
Bypass Flows	86	0.01	75
Total with Bypass	**233,560**	**28.84**	**100**

*presented as combined TP Load

Rainfall: For the 31-year period, daily estimates of rainfall over the surface of STA-2 were taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name "2050wPROJ_rfet.xls" dated March 11, 2002; worksheet identification "RF-STAs(inches)"). The average annual rainfall over the surface of STA-2 as reflected in that data file is estimated to be 51.31".

Evapotranspiration: Daily estimates of evapotranspiration over the surface of STA-2 were also taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name "2050wPROJ_rfet.xls" dated March 11, 2002; worksheet identification "ET-STAs(inches)"). The average annual evapotranspiration over the surface of STA-2 as reflected in that data file is estimated to be 57.40”. It should here be noted that the daily ET values were estimated as specific to the operation of STA-2 under the 2050 “with-CERP” simulation, and may not be fully representative of ET for the baseline condition. However, the analysis is not sensitive to minor variations in ET, and further refinement of those daily estimates is considered unnecessary for feasibility-level analyses.

3.1.2 Summary of Input Variables

The following paragraphs summarize input variables employed in the analysis of Existing Conditions for STA-2. Input variables include hydraulic properties, seepage, treatment parameters, and number of CSTRs.

Hydraulic Properties: Depth-discharge relationships specified in the DMSTA input file for each cell of STA-2 were based on analysis of detailed information presented in the “General Design Memorandum, Stormwater Treatment Area No. 2 and WCA 2A Hydropattern Restoration, Volume II of II, April 1995.” The DMSTA “default” parameters for emergent macrophytic vegetative and SAV communities were adjusted to closely approximate the relationships developed from that source. A summary of that analysis is presented in Table 3.2. The outlet control depth in each cell was established at 40 cm (approx. 15”) for the emergent macrophytic vegetation and 60 cm (approx. 24”) for the SAV community, consistent with the current design basis of STA-2.

Seepage: Generalized estimates of seepage losses from STA-2 were taken from information presented in the April 26, 1996 Technical Memorandum, *Seepage and Groundwater Interaction* included with the Final Amendment No. 1 of the *August 1996 General Design Detailed Design, Stormwater Treatment Area 2 and Water Conservation Area 2A Hydropattern Restoration, Contract No. C-E201A.* As presented in the April 26, 1996 Technical Memorandum, two and three-dimensional modeling using aquifer parameters estimated from monitoring data collected at the Everglades Nutrient Removal

(ENR) project site. Two-dimensional modeling was performed using the SEEP 2D model developed by the U.S. Army Waterways Experimental Station. The computer code MODLFOW, developed by the U.S. Geological Survey (USGS), was used to perform detailed three-dimensional modeling.

Table 3.2 STA-2 Hydraulic Properties, Existing Design (Baseline 2007-2014)

Cell	Mean Ground Elev.(ft. NGVD)	Discharge (cfs)	Discharge(hm3/d)	Ave. Cell Width (km)	Mean Stage (ft NGVD)	Mean Depth (ft)	Depth (m)	Coeff. A (m)	Exp. B	Computed Discharge (hm3/d)	Ratio, Comp. Q/Target
1	11.00	92	0.224	1.58	13.00	2.00	0.610	0.52	2.63	0.224	1.00
	11.00	775	1.896	1.58	15.50	4.50	1.372	0.52	2.63	1.886	0.99
2	11.00	115	0.282	2	13.00	2.00	0.610	0.66	3.1	0.285	1.01
	11.00	1,445	3.535	2	15.50	4.50	1.372	0.66	3.1	3.515	0.99
3	10.00	115	0.282	2	12.00	2.00	0.610	0.57	2.84	0.280	0.99
	10.00	1,150	2.814	2	14.50	4.50	1.372	0.57	2.84	2.797	0.99

Seepage losses, percent recovery and water elevations for anticipated average (representative) conditions are shown schematically in Figure 2-5.8, SEEP2D SEEPAGE QUANTITIES FOR REPRESENTATIVE CONDITIONS, of the subject reference. A summary of the seepage losses and estimated recoveries from the various cells of STA-2, based on the information presented in the subject reference, is presented in Table 3.3.

Table 3.3 Estimated Seepage Loss Rates and Recovery from STA-2

Cell	Location	Length (ft)	Seepage Rate (ft3/d/ft/ft)	Total Seepage (ft3/d/ft)	Cell Area (ac)	Loss Rate (cm/d/cm)	Combined Loss (cm/d/cd)	% Recovery	Combined % Recovery
1	North	5,400	51.3	277,020	1,800	0.00353	0.004	**78**	**78**
	East	17,500	-38.0	-665,000	1,800	-0.00848	-0.008	**-**	**Inflow**
2	North	11,300	51.3	579,690	2,270	0.00586	0.006	**78**	**78**
3	North	6,500	51.3	333,450	2,270	0.00337	0.010	**78**	**79**
	West	15,100	40.6	613,060	2,270	0.00620		**79**	
Cell	**Location**	**Ave. Grade (ft. NGVD)**	**Control Elev. (ft. NGVD)**	**Relative to Ave. Grade (ft)**	**Relative to Ave. Grade (cm)**	**Remarks**			
1	North	11.00	**9.00**	-2	-61	Control Elevation Seepage Canal			
1	East	11.00	**13.50**	2.5	76	Est. Ave. Stage in WCA-2A			
2	North	11.00	**9.00**	-2	-61	Control Elevation Seepage Canal			
3	North/West	10.00	**9.00**	-1	-30	Control Elevation Seepage Canal			

A limitation of the DMSTA model is that all recovered seepage losses, when returned to the treatment area, are returned to the cell from which they occur. The design of STA-2 is developed to return all recovered seepage from the north, east and west lines of the treatment area to the upstream end of all cells. That condition cannot be represented in the DMSTA analysis.

Treatment Parameters: As presently designed, Cells 1 and 2 of STA-2 are intended to consist of emergent macrophytic marsh while Cell 3 is SAV. Default values in the DMSTA model for Emergent and SAV communities were employed in the analysis of existing conditions.

No. of CSTRs in Series: For this analysis, a total of three Continuous Stirred Tank Reactors (CSTRs) in series was assigned in each cell.

3.1.3 Results of DMSTA Analysis for Existing Conditions (Baseline 2007-2014)

A detailed listing of input variables employed in the analysis of Existing Conditions for STA-2, together with a detailed listing of computed output variables resulting from that analysis is presented in Table 3.4 (which consists of screen information taken directly from the DMSTA output file).

Table 3.4 Results of DMSTA Analysis, STA-2 Existing Design (Baseline 2007-2014)

Case Description: Existing, Cells 1 & 2--Emergent, & 3--SAV_C4
Filename: 2EX_Data.xls

Input Variable	Units	Value
Design Case Name	-	BASELINE
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.1%
Flow-Wtd Conc - With Bypass	ppb	33.0
Flow-Wtd Conc - Without Bypass	ppb	33.0
Geometric Mean Conc	ppb	33.4
95th Percentile Conc	ppb	47.7
Freq Cell Outflow > 10 ppb	%	46%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3			
Vegetation Type	------->	EMERG	EMERG	SAV_C4			
Inflow Fraction	-	0.28	0.36	0.36			
Downstream Cell Number	-	0	0	0			
Surface Area	km2	7.280	9.190	9.190			
Mean Width of Flow Path	km	1.58	2.00	2.00			
Number of Tanks in Series	-	3	3	3			
Outflow Control Depth	cm	40	40	60			
Outflow Coefficient - Exponent	-	2.63	3.1	2.84			
Outflow Coefficient - Intercept	-	0.52	0.66	0.57			
Bypass Depth	cm	0	0	0			
Maximum Inflow	hm3/day	0	0	0			
Maximum Outflow	hm3/day	0	0	0			
Inflow Seepage Rate	(cm/d) / cm	0.008	0	0			
Inflow Seepage Control Elev	cm	76	0	0			
Inflow Seepage Conc	ppb	20	20	20			
Outflow Seepage Rate	(cm/d) / cm	0.004	0.006	0.01			
Outflow Seepage Control Elev	cm	-61	-61	-30			
Max Outflow Seepage Conc	ppb	20	20	20			
Seepage Recycle Fraction	-	0.78	0.78	0.79			
Seepage Discharge Fraction	-	0	0	0			
Initial Water Column Conc	ppb	30	30	30			
Initial P Storage Per Unit Area	mg/m2	500	500	500			
Initial Water Column Depth	cm	50	50	50			
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*			
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*			
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*80.10*			
Zx = Depth Scale Factor	cm	*60*	*60*	*60*			
C0 - Periphyton	ppb	*0*	*0*	*0*			
C1 - Periphyton	ppb	*0*	*0*	*0*			
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*			
Zx - Periphyton	cm	*0*	*0*	*0*			
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*			
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*			

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.94	13.19	19.45				19.45
Run Date	-	07/14/02	07/14/02	07/14/02				07/14/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65				01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65				01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95				12/31/95
Output Duration	days	11322	11322	11322				11322
Cell Label		1	2	3				Total Outflow
Downstream Cell Label		Outflow	Outflow	Outflow				-
Surface Area	km2	7.280	9.19	9.19				25.7
Mean Water Load	cm/d	3.0	3.1	3.1				3.1
Max Water Load	cm/d	30.6	31.2	31.2				31.1
Inflow Volume	hm3/yr	80.7	103.8	103.8				288.2
Inflow Load	kg/yr	8079.5	10387.9	10387.9				28855.2
Inflow Conc	ppb	100.1	100.1	100.1				100.1
Treated Outflow Volume	hm3/yr	81.8	97.5	95.9				275.3
Treated Outflow Load	kg/yr	3399.6	4125.7	1554.9				9080.2
Treated FWM Outflow Conc	ppb	41.5	42.3	16.2				33.0
Total FWM Outflow Conc	ppb	41.5	42.3	16.2				33.0
Surface Outflow Load Reduc	%	57.9%	60.3%	85.0%				68.5%
Outflow Geometric Mean - Daily	ppb	39.0	39.3	10.6				32.6
Outflow Geo Mean - Composites	ppb	39.8	40.3	10.2				33.4
Frequency Outflow Conc > 10 ppb	%	100%	100%	0%				100%

A condensed summary of the results of the analysis is presented in Table 3.5.

Table 3.5 Discharge Summary, STA-2 Existing Conditions (Baseline 2007-2014)

Parameter	**Units**	**Value**
Average Annual Outflow Volume	Hm^3/yr	275.3
Average Annual Outflow Volume	Ac-ft/yr	223,200
Average Annual Outflow TP Load	Kg/yr	9,080.2
Flow-weighted Mean TP Concentration	ppb	33
Geometric Mean TP Concentration, weekly composites	ppb	33

3.2 Baseline 2015-2056 Conditions

Basins tributary to several STAs are scheduled to receive component projects of the Comprehensive Everglades Restoration Program (CERP). The most significant of these is the component entitled "EAA Storage Reservoir, Phase 1". That project was authorized in the Water Resources Development Act (WRDA) of 2000, and is presently scheduled for completion in September 2009. The full CERP Simulation (2050wPROJ) prepared for the feasibility studies includes Phase 1 and 2 of the EAA Storage Reservoir Project, with Phase 2 considered complete by 2014. As a result, Baseline 2015-2056 conditions should properly be considered as those that will result from implementation of the EAA Storage Reservoir Phase 1 and 2 project, and other elements of CERP that may substantially influence inflows to STA-2. In this case, STA-2, although not receiving waters from any of the Reservoirs, will be affected by the redistribution of the waters around the Everglades Agricultural Area. For this analysis, Baseline 2015-2056 conditions are assigned to the 42-year period 2015-2056.

3.2.1 STA-2 Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Baseline 2015-2056 Conditions for STA-2. Daily inflow rates, TP concentrations, rainfall and evaportranspiration employed in the DMSTA analysis of that condition are included in an Excel file “2FU_Data.xls”.

Inflow Volumes and TP Loads: Daily inflow volumes to STA-2 were taken from a District-furnished Excel file (“sta2in.xls” dated March 7, 2002). Daily inflow TP concentrations by source were assigned at values equal to those used in analysis of existing conditions at STA-2. A summary of the estimated average annual inflow volumes and loads to STA-2 under the Baseline 2015-2056 condition is presented in Table 3.6.

Table 3.6 Estimated Inflows, STA-2 Future Analysis, 2015-2056

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
S-2/S-6 Basin			
Hills Canal	144,296	16.02	90
WPB Canal	42,327	6.27	0
Drainage District 298	14,409	3.66	206
BMP MUW Hills Canal	7,235	*	*
Water Supply	122	*	*
Combined STA2 BMP / Water Supply	7,357	0.67	74
Total Average Annual Inflows	**208,389**	**26.62**	**104**

* presented as combined TP Load

Estimated average annual inflow volumes and TP loads to STA-2 under Baseline 2015-2056 condition are reduced 10.8% and 7.7%, respectively, from those estimated for Existing Conditions (Baseline 2007-2015).

Daily Rainfall and Evapotranspiration were assigned equal to those reflected in the analysis of Existing Conditions for STA-2.

3.2.2 Summary of Input Variables

All input variables for analysis of the Baseline 2015-2056 Condition at STA-2 were assigned values identical to those employed in the Existing Conditions (Baseline 2007-2014) analysis for STA-2. Those input variables, listed below, are defined in an Excel worksheet entitled "Baseline 2015-2056" included in the workbook "2FU_xls".

3.2.3 Results of DMSTA Analysis for Baseline 2015-2056

A detailed listing of input variables employed in the analysis of the Baseline 2015-2056 Condition for STA-2, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 3.8 (which consists of screen information taken directly from the DMSTA output files).

A condensed summary of the results of the analysis is presented in Table 3.7.

Table 3.7 Discharge Summary, STA-2 Baseline 2015-2056 Design

Parameter	**Units**	**Value**
Average Annual Outflow Volume	Hm^3/yr	244.3
Average Annual Outflow Volume	Ac-ft/yr	198,100
Average Annual Outflow TP Load	Kg/yr	7,482.6
Flow-weighted Mean TP Concentration	ppb	31
Geometric Mean TP Concentration, weekly composites	ppb	32

Estimated average annual outflow volumes and TP loads from STA-2 under the Baseline 2015-2056 condition are reduced 11.2% and 17.6%, respectively, from those estimated for Existing Conditions (Baseline 2007-2014).

Table 3.8 Results of DMSTA Analysis, Baseline 2015-2056 STA-2 Design

Input Variable	**Units**	**Value**	**Case Description:**		**Filename:** 2FU_Data.xls
Design Case Name	-	FUTURE	Existing, Cells 1 & 2--Emergent & Cell 3--SAV_C4		
Starting Date for Simulation	-	01/01/65			
Ending Date for Simulation	-	12/31/95			
Starting Date for Output	-	01/01/65			
Steps Per Day	-	3	**Output Variable**	**Units**	**Value**
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	0.1%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	30.6
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	30.6
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	31.7
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	44.9
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	41%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**
Cell Label	-	1	2	3			
Vegetation Type	------->	EMERG	EMERG	SAV_C4			
Inflow Fraction	-	0.28	0.36	0.36			
Downstream Cell Number	-	0	0	0			
Surface Area	km2	7.280	9.190	9.190			
Mean Width of Flow Path	km	1.58	2.00	2.00			
Number of Tanks in Series	-	3	3	3			
Outflow Control Depth	cm	40	40	60			
Outflow Coefficient - Exponent	-	2.63	3.1	2.84			
Outflow Coefficient - Intercept	-	0.52	0.66	0.57			
Bypass Depth	cm	0	0	0			
Maximum Inflow	hm3/day	0	0	0			
Maximum Outflow	hm3/day	0	0	0			
Inflow Seepage Rate	(cm/d) / cm	0.008	0	0			
Inflow Seepage Control Elev	cm	76	0	0			
Inflow Seepage Conc	ppb	20	20	20			
Outflow Seepage Rate	(cm/d) / cm	0.004	0.006	0.01			
Outflow Seepage Control Elev	cm	-61	-61	-30			
Max Outflow Seepage Conc	ppb	20	20	20			
Seepage Recycle Fraction	-	0.78	0.78	0.79			
Seepage Discharge Fraction	-	0	0	0			
Initial Water Column Conc	ppb	30	30	30			
Initial P Storage Per Unit Area	mg/m2	500	500	500			
Initial Water Column Depth	cm	50	50	50			
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*			
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*			
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*80.10*			
Zx = Depth Scale Factor	cm	*60*	*60*	*60*			
C0 - Periphyton	ppb	*0*	*0*	*0*			
C1 - Periphyton	ppb	*0*	*0*	*0*			
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*			
Zx - Periphyton	cm	*0*	*0*	*0*			
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*			
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*			

Output Variables	**Units**	**1**	**2**	**3**	**4**	**5**	**6**	**Overall**
Execution Time	seconds/yr	6.90	13.29	19.74				19.74
Run Date	-	07/14/02	07/14/02	07/14/02				07/14/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65				01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65				01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95				12/31/95
Output Duration	days	11322	11322	11322				11322
Cell Label		1	2	3				Total Outflow
Downstream Cell Label		Outflow	Outflow	Outflow				-
Surface Area	km2	7.280	9.19	9.19				25.7
Mean Water Load	cm/d	2.7	2.8	2.8				2.7
Max Water Load	cm/d	25.5	26.0	26.0				25.9
Inflow Volume	hm3/yr	72.0	92.6	92.6				257.3
Inflow Load	kg/yr	7460.0	9591.5	9591.5				26642.9
Inflow Conc	ppb	103.6	103.6	103.6				103.6
Treated Outflow Volume	hm3/yr	73.2	86.3	84.8				244.3
Treated Outflow Load	kg/yr	2850.7	3424.1	1207.9				7482.6
Treated FWM Outflow Conc	ppb	38.9	39.7	14.2				30.6
Total FWM Outflow Conc	ppb	38.9	39.7	14.2				30.6
Surface Outflow Load Reduc	%	61.8%	64.3%	87.4%				71.9%
Outflow Geometric Mean - Daily	ppb	37.3	37.8	9.9				31.1
Outflow Geo Mean - Composites	ppb	38.0	38.7	9.4				31.7
Frequency Outflow Conc > 10 ppb	%	100%	#DIV/0!	#DIV/0!				100%

3.3 Baseline Condition for Evaluation of Alternative 1

The Evaluation Methodology requires a comparison of the performance of various alternatives for improved treatment performance in STA-2 to a Baseline condition. The Baseline condition at STA-2 consists of a combination of Existing Conditions (Baseline 2007-2014) and Future conditions (Baseline 2015-2056). The performance of STA-2 under Existing conditions is applied to the period 2007-2014 (8 years). The performance of STA-2 under Future conditions is applied to the period 2015-2056 (42 years). Table 3.9 presents a summary of the Baseline discharges from STA-2 against which discharges from the various alternatives will be evaluated.

Table 3.9 STA-2 Baseline Total Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	223,200	9,080.2	1,785,600	72,642
2015	2056	198,100	7,482.6	8,320,200	314,269
2007	**2056**	**202,116**	**7,738.2**	**10,105,800**	**386,911**
Flow-weighted mean TP Concentration in Discharges, ppb					**31**

3.4 Alternative No. 1

Under Alternative No. 1, Cells 1, 2 and 3 would be modified to optimize the performance of STA-2, with completion of all modifications and placement into service of the modified treatment area occurring in 2006. For this analysis, that optimization is considered to consist of the conversion of the downstream 1,080 acres (60%) of Cell 1, and the downstream 1,360 acres (60%) of Cell 2 to SAV.

A schematic of STA-2, under Alternative 1 is presented in Figure 3.2.

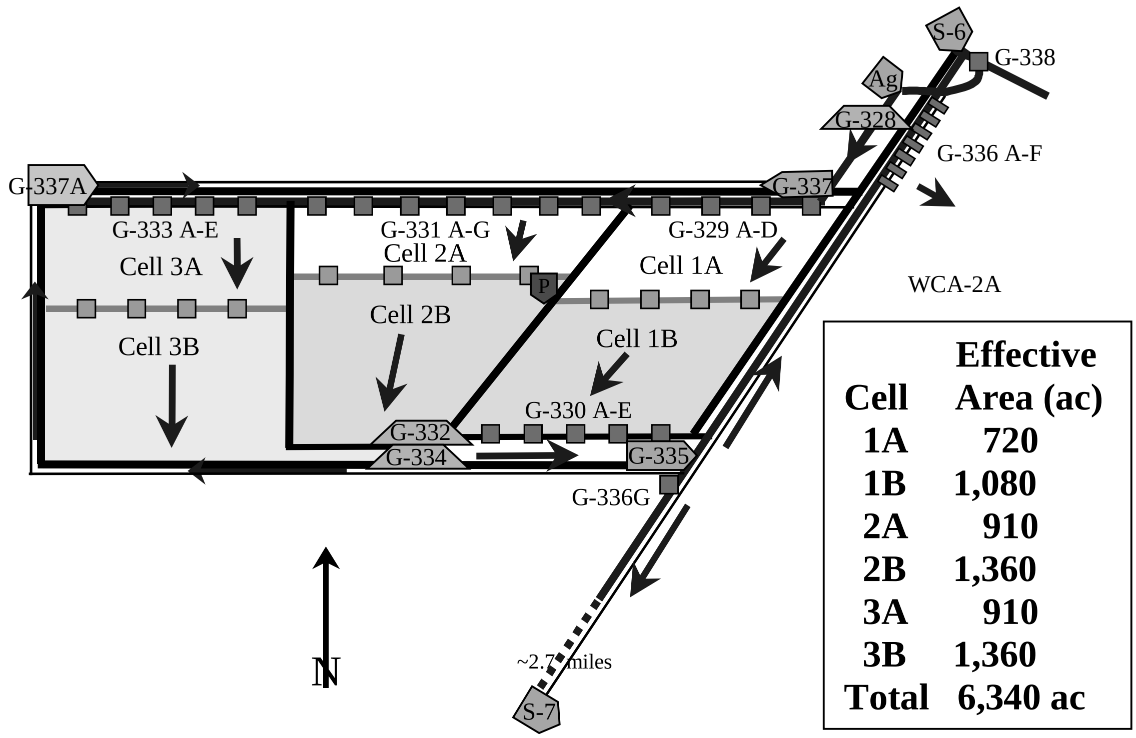


Figure 3.2. Schematic of STA-2, under Alternative 1

3.4.1 Treatment Analysis Input Data Summary

As this alternative is considered as complete in 2006, the operation of STA-2 under Alternative No. 1 would be divided into two distinct periods: Existing (2007-2014) and Future (2015-2056). The optimized configuration is similar for both Existing and Future conditions. As such, Alternative 1 inflow volumes and TP loads for Existing and Future conditions are identical to inflow volumes and TP loads for the Baseline Existing conditions (Baseline 2007-2014) and Future conditions (Baseline 2015-2056), respectively. Accordingly, inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 1 are taken from “2EX_Data.xls” and “2FU_Data.xls” Excel files. Inflow volumes and TP loads are identical to those summarized in Tables 3.1 and 3.6

3.4.2 Summary of Input Variables for Treatment Data Summary

Other than discussed below, input variables employed in the analysis of Alternative 1 for STA-2 are identical to those included in the Existing and Future Baseline Conditions analyses.

- Cells 1, 2, and 3 were subdivided into two cells each:
  - Cell 1A (720 acres) and Cell 1B (1,080 acres)
  - Cell 2A (910 acres) and Cell 2B (1,360 acres)
  - Cell 3A (910 acres) and Cell 3B (1,360 acres)
- The Outflow Control Depth in Cells 1B and 2B was modified from 40 cm to 60 cm.
- The vegetation type in Cell 1B and 2B was revised from “Emergent” to “SAV_C4”, and the associated default treatment parameters of DMSTA were employed in the analysis.
- The hydraulic information remained similar except for the change in cell width for Cells 2A and 2B.
- The seepage transfer rates for all Cells 1A, 2A, and 3A were adjusted based on their new cell size. Cell 1B seepage is based on its associated inflow seepage on its eastern border with WCA-2A. Cell 2B seepage was set at zero. Cell 3 seepage is based on its associated seepage on its western border of the STA.

3.4.3 Results of DMSTA Analysis for Alternative 1

A detailed listing of input variables employed in the analysis of the Alternative 1 Existing Condition (2007-2014) for STA-2, together with a detailed listing of computed output variables resulting from that analysis is presented in Table 3.10 (which consists of screen information taken directly from the DMSTA output file).

Table 3.10 Results of DMSTA Analysis, STA-2 Alternative 1 (2007-2014)

Input Variable	Units	Value
Design Case Name	-	ALT1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Existing, Cells 1A & 2A--Emergent & Cell 1B, 2B, 3A & 3B--SAV_C4 40/60 Split **Filename:** 2EX_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	16.6
Flow-Wtd Conc - Without Bypass	ppb	16.6
Geometric Mean Conc	ppb	8.8
95th Percentile Conc	ppb	23.6
Freq Cell Outflow > 10 ppb	%	34%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	SAV_C4	SAV_C4
Inflow Fraction	-	0.28	0	0.36	0	0.36	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	2.912	4.368	3.676	5.514	3.676	5.514
Mean Width of Flow Path	km	1.58	1.58	3.10	1.65	2.00	2.00
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	40	60	60	60
Outflow Coefficient - Exponent	-	2.48	2.53	2.92	1.99	2.93	3.05
Outflow Coefficient - Intercept	-	0.48	0.62	0.39	1.28	0.48	0.64
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.008	0.008	0	0	0	0
Inflow Seepage Control Elev	cm	76	76	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.009	0	0.015	0	0.015	0.006
Outflow Seepage Control Elev	cm	-61	0	-61	0	-30	-30
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.78	0	0.78	0	0.78	0.79
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*80.10*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.71	12.81	19.13	25.20	31.29	37.36	37.36
Run Date	-	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	2.912	4.368	3.676	5.514	3.676	5.514	25.7
Mean Water Load	cm/d	7.6	5.0	7.7	4.9	7.7	4.9	3.1
Max Water Load	cm/d	76.6	50.1	78.0	52.1	78.0	52.2	31.1
Inflow Volume	hm3/yr	80.7	80.0	103.8	98.4	103.8	99.1	288.2
Inflow Load	kg/yr	8079.5	5120.9	10387.9	6179.1	10387.9	2886.5	28855.2
Inflow Conc	ppb	100.1	64.0	100.1	62.8	100.1	29.1	100.1
Treated Outflow Volume	hm3/yr	80.0	81.1	98.4	97.6	99.1	95.9	274.6
Treated Outflow Load	kg/yr	5120.9	1375.2	6179.1	1806.1	2886.5	1386.8	4568.1
Treated FWM Outflow Conc	ppb	64.0	17.0	62.8	18.5	29.1	14.5	16.6
Total FWM Outflow Conc	ppb	64.0	17.0	62.8	18.5	29.1	14.5	16.6
Surface Outflow Load Reduc	%	36.6%	73.1%	40.5%	70.8%	72.2%	52.0%	84.2%
Outflow Geometric Mean - Daily	ppb	61.8	9.9	59.3	10.3	20.3	8.3	9.1
Outflow Geo Mean - Composites	ppb	63.2	9.5	61.1	10.2	20.5	8.0	8.8
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	0%	100%	0%	36%

A condensed summary of the results of the analysis is presented in Table 3.11.

Table 3.11 Discharge Summary, STA-2 Alternative 1 2007-2015

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	274.6
Average Annual Outflow Volume	Ac-ft/yr	222,600
Average Annual Outflow TP Load	Kg/yr	4,568.1
Flow-weighted Mean TP Concentration	ppb	17
Geometric Mean TP Concentration, weekly composites	ppb	10**

**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

A detailed listing of input variables employed in the analysis of Alternative 1 Future Condition (2015-2056) for STA-2, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 3.13 (which consists of screen information taken directly from the DMSTA output files).

A condensed summary of the results of the analysis is presented in Table 3.12.

Table 3.12 Discharge Summary, STA-2 Alternative 1 2015-2056

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	243.6
Average Annual Outflow Volume	Ac-ft/yr	197,500
Average Annual Outflow TP Load	Kg/yr	3,521.6
Flow-weighted Mean TP Concentration	ppb	14
Geometric Mean TP Concentration, weekly composites	ppb	10**

**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

Table 3.13 Results of DMSTA Analysis, STA-2 Alternative 1 2015-2056

Input Variable	Units	Value
Design Case Name	-	ALT1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Existing, Cells 1A & 2A--Emergent & Cell 1B, 2B, 3A & 3B--SAV_C4
40/60 Split

Filename: 2FU_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	14.5
Flow-Wtd Conc - Without Bypass	ppb	14.5
Geometric Mean Conc	ppb	8.1
95th Percentile Conc	ppb	20.3
Freq Cell Outflow > 10 ppb	%	28%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	SAV_C4	SAV_C4
Inflow Fraction	-	0.28	0	0.36	0	0.36	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	2.912	4.368	3.676	5.514	3.676	5.514
Mean Width of Flow Path	km	1.58	1.58	3.10	1.65	2.00	2.00
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	40	60	60	60
Outflow Coefficient - Exponent	-	2.48	2.53	2.92	1.99	2.93	3.05
Outflow Coefficient - Intercept	-	0.48	0.62	0.39	1.28	0.48	0.64
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.008	0.008	0	0	0	0
Inflow Seepage Control Elev	cm	76	76	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.009	0	0.015	0	0.015	0.006
Outflow Seepage Control Elev	cm	-61	0	-61	0	-30	-30
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.78	0	0.78	0	0.78	0.79
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*80.10*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	7.39	13.52	19.97	26.68	32.84	39.00	39.00
Run Date	-	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	2.912	4.368	3.676	5.514	3.676	5.514	25.7
Mean Water Load	cm/d	6.8	4.5	6.9	4.3	6.9	4.4	2.7
Max Water Load	cm/d	63.8	42.0	65.0	43.4	65.0	43.7	25.9
Inflow Volume	hm3/yr	72.0	71.3	92.6	87.2	92.6	87.9	257.3
Inflow Load	kg/yr	7460.0	4430.2	9591.5	5305.6	9591.5	2284.3	26642.9
Inflow Conc	ppb	103.6	62.1	103.6	60.8	103.6	26.0	103.6
Treated Outflow Volume	hm3/yr	71.3	72.5	87.2	86.4	87.9	84.8	243.6
Treated Outflow Load	kg/yr	4430.2	1069.6	5305.6	1392.2	2284.3	1059.8	3521.6
Treated FWM Outflow Conc	ppb	62.1	14.8	60.8	16.1	26.0	12.5	14.5
Total FWM Outflow Conc	ppb	62.1	14.8	60.8	16.1	26.0	12.5	14.5
Surface Outflow Load Reduc	%	40.6%	75.9%	44.7%	73.8%	76.2%	53.6%	86.8%
Outflow Geometric Mean - Daily	ppb	61.6	9.2	59.7	9.5	19.1	7.7	8.5
Outflow Geo Mean - Composites	ppb	62.7	8.7	60.9	9.2	19.2	7.2	8.1
Frequency Outflow Conc > 10 ppb	%	100%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	31%

Table 3.14 summarizes the estimated total discharges from STA-2, Alternative 1 over the 50-year period 2007-2056, given that:

- STA-2 will operate under Alternative 1, Existing conditions, over the period 2007-2014.
- STA-2 will operate under Alternative 1, Future conditions, over the period 2015-2056.

Table 3.14 STA-2 Alt. 1, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	222,600	4,568.1	1,780,800	36,545
2015	2056	197,500	3,521.6	8,295,000	147,907
2007	**2056**	**201,500**	**3,689.0**	**10,075,800**	**184,452**
Flow-weighted mean TP Concentration in Discharges, ppb					**15**

Estimated average annual outflow volumes and TP loads from STA-2 under the Alternative 1 Future Conditions (2015-2056) are reduced 11.3% and 21.2%, respectively, from those estimated for Existing Conditions (2007-2014).

3.4.4 Opinion of Probable Capital Cost

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 1:

- Construction of approximately 3.3 miles of interior levee, subdividing Cell 1 into Cells 1A and 1B, Cell 2 into Cells 2A and 2B, and Cell 3 into 3A and 3B.
- Construction of additional water control structures through the new levee between cells in series. Four control structures are assigned to each cell, and assumed to be equivalent in number and character to STA-3/4's G-381 Structures (8'x8' gated RCB's with telemetric control).

- Extension of an overhead power distribution line from the intersection of the new levee with the eastern border Cell 1, and then west along the new levee across Cells 1, 2 & 3 (total length of approximately 3.3 miles).
- One small forward-pumping station along the new interior Cell 2 levee to permit withdrawal from upstream emergent marsh cell to maintain stages in the downstream SAV cell. This station pumping from Cell 2A to Cell 2B is assigned a preliminary capacity of 14 cfs (equal to a maximum daily evaporation rate from Cell 2B of 0.24"/day).
- Herbicide treatment of Cells 1B, 2B and 500 acres of 3A/3B (conversion of remaining emergent vegetation) for removal of emergent macrophyte vegetation to permit development of SAV.

An opinion of the probable capital cost for Alternative 1 is presented in Table 3.15.

Table 3.15 Opinion of Probable Capital Cost, STA-2 Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee, 7' height (Excludes Blasting Costs)	3.3	Mi.	$390,000	$1,287,000	Unit cost from Evaluation Methodology
2	Blasting for New Levee and Canals	3.3	Mi.	$48,000	$158,400	Allow Approx.$1/cy
3	New Water Control Structures (8'x8')	12	Ea.	$190,000	$2,280,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
4	Water Control Structure Electrical (Includes Telemetry)	12	Ea.	$43,000	$516,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
5	Stilling Wells (Includes Electrical and Telemetry)	6	Ea.	$9,000	$54,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
6	Electrical Power Distribution	3.3	Mi.	$80,000	$264,000	Unit cost from Evaluation Methodology
7	Pumping Station, Cell 2A-2B	14	cfs	$7,600	$106,400	Unit cost from Evaluation Methodology
8	Eradication of Existing Vegetation	2940	ac	$200	$588,000	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$5,253,800**	**5,250,000**
Planning, Engineering & Design			10 %		$525,380	**530,000**
Program & Construction Management			10 %		$525,380	**530,000**
Total Estimated Cost, Without Contingency					**$6,304,560**	**6,310,000**
Contingency			30 %		$1,891,368	**1,890,000**
TOTAL ESTIMATED CAPITAL COST					**$8,195,928**	**8,200,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

3.4.5 Opinion of Probable Annual Costs for Operation & Maintenance

The following is a summary listing of the anticipated incremental operation and maintenance requirements for Alternative 1 (e.g., requirements in addition to those for operation of maintenance of STA-2 as presently designed):

- Maintenance of approximately 3.3 additional miles of interior levee.
- Operation and maintenance of the additional water control structures through the new levee subdividing Cell 1 into Cells 1A and 1B, Cell 2 into Cells 2A and 2B, and Cell 3 into 3A and 3B.
- Operation and maintenance of one small forward-pumping station along the interior levee in Cell 2 between cells in series, included in the design to permit withdrawal from upstream emergent marsh cells to maintain stages in the downstream SAV cells. The pump in this station is assumed to be driven by electric motor. The unit operating costs are estimated using a power cost of $0.08/kw-hr; an assumed total head of 6 feet; an overall efficiency of 85%; and an assigned utilization equal to 10% of the overall time. The resultant power consumption is 0.43 kw/cfs, or 3,770 kw-hr/cfs/yr., yielding an approximate average annual cost of $300/yr/cfs.
- Additional herbicide treatment of Cells 1B, 2B and 500 acres of 3A/3B (conversion of remaining emergent vegetation) for control of invasive species and emergent macrophyte vegetation. This item includes both:
  - Annual costs to spray for invasive species.
  - Additional costs for post-drought eradication of undesirable species.

The February 22, 2002 Draft *Supplemental Technology Standard of Comparison (STSOC) Analysis for Submerged Aquatic Macrophyte/Limerock Technology*, D.B Environmental, presents an estimated cost of $25/acre/year for regular herbicide treatment for control of invasive species, and an additional $10/acre/year for post-drought eradication spraying. Given the inclusion of the forward-pumping stations for maintenance of stages in the SAV cells, the opinion of probable incremental operation and maintenance cost includes a substantially reduced allowance of $10/acre/year for both those items.

An opinion of the probable incremental operation and maintenance cost for Alternative 1 is presented in Table 3.16.

Table 3.16 Opinion of Probable Incremental O&M Cost, STA-2 Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee	3.3	Mi.	$1,530	$5,049	Unit cost from Evaluation Methodology
2	New Water Control Structures	12	Ea.	$12,000	$144,000	Unit cost from Evaluation Methodology
3	Mech. Maintenance, Pumping Station, Cell 2A-2B, 1 unit assumed	1	Ea.	$10,000	$10,000	Unit cost from Evaluation Methodology
4	Power Consumption, Pumping Station, Cell 2A-2B	14	cfs	$300	$4,200	See text for basis of estimated unit cost
5	Incremental Cost forAnnual Vegetation Control	2940	ac	$10	$29,400	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$192,649**	
Contingency		30 %			$57,795	
TOTAL INCREMENTAL O&M COST					**$250,444**	**$250,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

3.4.6 Total Present Worth

The total present cost of Alternative 1 is presented in Table 3.17, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation of 3%.

Table 3.17 Total Present Worth, STA-2 Alternative 1

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present**
Year		**PED**	**P&CM**	**Const.**	**Total**	**Worth**
2003		$545,900			$545,900	$513,184
2004			$281,139	$3,787,413	$4,068,552	$3,595,511
2005			$289,573	$3,901,035	$4,190,608	$3,481,435
Total Capital Cost					$8,805,060	$7,590,131
Incremental Costs for Operation and Maintenance						**Present**
From	**To**			**Total O&M Cost**		**Worth**
2007	2056				$32,690,621	$5,155,937
Total Present Worth of Alternative						**$12,746,068**

3.5 Summary of Evaluation Criteria Scoring

The following tables present summaries of the evaluation criteria scoring for the alternative water quality improvement strategies for STA-2. The information presented therein will subsequently be employed by the District and others in further evaluation of the alternatives, and identification of that alternative or alternative(s) to be carried forward to the conceptual design phase.

Table 3.18 Summary Evaluation Criteria Scores, STA-2 Alternative 1

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	387	Table 3.9
		50-Year TP Load Disc. - Alternative 1	tonnes	184	Table 3.14
		Phosphorus Load Reduction	%	52.3	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	14	Table 3.13
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10**	Table 3.13
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$12,746,068	Table 3.17
	2	Total 50-Year TP Removal	kg	202,459	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$62.96	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

** Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

3.6 Sensitivity Analyses of Phosphorus Reduction Parameters

The effectiveness of phosphorus reduction in the alternatives considered are examined with respect to the change in the following three input parameters presented in the sensitivity analyses:

- Varying BMP Performance
- Different SAV Communities
- All Input Parameters
  - Uncertainty Analysis

The third analysis (all input parameters) also employs an uncertainty analysis. The information presented therein will assist the District in further analyses of the alternatives presented in the future evaluation of the parameters.

3.6.1 Variation in BMP Performance

The current level of 50% TP load reduction in basin runoff due to BMPs in the EAA was varied to 25% and 75% TP load reduction to determine the effects the performance level of BMP on the phosphorus reduction parameters. The TP inflows into STA-2 were recalculated, including those involving the EAA Storage Reservoir. Table 3.19 summarizes the outcome of the phosphorus reduction performance due to varying BMP performance.

Table 3.19 Variation in BMP Performance

Condition	Location	TP Conc. For BMP Load Reduction in S-2 & S-6 Basins of					
		25%		50%		75%	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
Baseline, Existing	STA-2 Inflows	146	--	100	--	54	--
	STA-2 Outflows	43	46	33	33	22	21
Baseline, Future	STA-2 Inflows	147	--	104	--	60	--
	STA-2 Outflows	40	42	31	32	21	21
Alternative-1, Existing	STA-2 Inflows	146	--	100	--	54	--
	STA-2 Outflows	19	11	17	10**	14*	10**
Alternative-1, Future	STA-2 Inflows	147	--	104	--	60	--
	STA-2 Outflows	16	10**	15	10**	14*	10**

*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

The results show that the phosphorus reduction performance is less sensitive to BMP performance with Alternative 1 than in the baseline conditions.

3.6.2 Variation in SAV Performance

The current vegetative community (SAV_C4) was changed to the vegetative community (NEWS) to determine the effects of different vegetative communities on the phosphorus reduction parameters. Table 3.20 summarizes, for Baseline and Alternatives 1, the outcome of the phosphorus reduction performance due to different SAV communities.

Table 3.20 Variation in SAV Performance

Condition	Location	TP Conc. For Different SAV Communities			
		SAV_C4		NEWS	
		F.W.	Geo.	F.W.	Geo.
Baseline (Pre-CERP)	STA-2 Inflows	100	--	100	--
	STA-2 Outflows	33	33	37	35
Baseline (Post-CERP)	STA-2 Inflows	104	--	104	--
	STA-2 Outflows	31	32	34	34
Alternative 1 (Pre-CERP)	STA-2 Inflows	100	--	100	--
	STA-2 Outflows	17	10**	28	14
Alternative 1 (Post-CERP)	STA-2 Inflows	104	--	104	--
	STA-2 Outflows	14	10**	24	13

**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

The results show that the phosphorus reduction performance is fairly sensitive to the vegetative community used for cells in series.

3.6.3 All Input Variables (DMSTA Sensitivity Model)

The sensitivity of the phosphorus reduction performance to all input variables available in the DMSTA model was tested through its built-in Sensitivity Model which also includes an Uncertainty Analysis module. The Sensitivity Model assesses the average percent change in these four output parameters for each input changed:

- Treated Flow-weighted Mean Outflow Concentration
- Total Flow-weighted Mean Outflow Concentration
- Outflow Geometric Mean – Composite
- Total Outflow Load

A Sensitivity Scale Factor of 25% (i.e. 25% change in each input) was used in all runs. Both high and low results were tested; in other words, two runs were conducted for each input variable, one at 75% and the other at 125% of the original value of the input variable under consideration. With approximately 25 different input variables, multiplied by the number of cells in the STA, and the high and low end of results tested, the Sensitivity Analysis included a potential of 100 or more DMSTA runs for each case.

No output from each run for each case exceeded 25%. The biggest changes in the four output variables, consistently across each case, were caused by the following input variables:

- Inflow Fraction
- Surface Area
- "K" Settling Rate

The DMSTA Model also includes an Uncertainty Analysis that lists the actual change of any one of the four above-listed output variables based on the "uncertainty" of the input variables. If one of the 23 variables (available in this analysis) under consideration is insensitive, then the range of values will not change significantly.

The DMSTA Uncertainty Analysis uses results from the above Sensitivity Model. The input into the model is the variable labeled "Error CV", which is the Standard Error divided by the Mean. The default input Error CV in the DMSTA model was utilized for the analyses. The outputs are the 10th, 50th, and 90th percentile estimate of the four listed output parameters.

Since the analysis of STA-2 includes no bypass analysis, the resultant Total Flow-weighted Mean Outflow Concentration is the same as the resultant Treated Flow-weighted Mean Outflow Concentration. Outputs from the four DMSTA cases are shown in Table 3.21:

Table 3.21 Uncertainty Analyses of All Input Variables

Condition	Location	TP Conc. In DMSTA Sensitivity Analyses								
		10th Percentile Est.			50th Percentile Est.			90th Percentile Est.		
		F.W.	Geo.	Load	F.W.	Geo.	Load	F.W.	Geo.	Load
Baseline, Existing	STA-2 Outflows	25	25	6,998	33	33	9,080	41	42	11,162
Baseline, Future	STA-2 Outflows	24	24	5,753	31	32	7,483	38	40	9,212
Alternative 1 Existing	STA-2 Outflows	14*	10**	3,854*	17	10**	4,568	20	11	5,612
Alternative 1 Future	STA-2 Outflows	14*	10**	3,422*	14	10**	3,522	18	10	4,330

* Increased from computed value to reflect lower limit of calibration range.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

The results show that there is a fairly wide range of uncertainty in phosphorus reduction performance, particularly in the baseline conditions.

Table of Contents

List of Tables

List of Figures

4. STORMWATER TREATMENT AREA NO. 3 & 4 (STA-3/4)

STA-3/4 is currently under construction; construction completion and startup is presently scheduled for October 2003. Upon completion, STA-3/4 will provide a total effective treatment area of 16,653 acres, situated generally between U.S. Highway 27 (on the east) and the Holey Land Wildlife Management Area (on the west), lying immediately north of the L-5 Borrow Canal. This stormwater treatment area is intended to treat inflows from the Miami Canal (via Pumping Station G-372) and the North New River Canal (via Pumping Station G-370). Those inflows are comprised of contributions from a number of sources, including:

- Agricultural runoff and discharges from the North New River Canal Basin (S-7/S-2 Basin).
- Agricultural runoff and discharges from the Miami Canal Basin (S-8/S-3 Basin).
- Lake Okeechobee. Anticipated inflows from Lake Okeechobee include:
  - Regulatory releases to both the Miami Canal and North New River Canal.
  - Best Management Practice (BMP) makeup water for both the Miami Canal and North New River Canal basins.
  - Supplemental (irrigation) water necessary to prevent dryout of the STA (considered as delivered to the Miami Canal).
- Agricultural runoff and discharges from the C-139 Basin (episodic inflows through Structure G-136 and the L-1E Canal to the Miami Canal).
- Pumping Station S-236 discharges to be diverted from Lake Okeechobee to the Miami Canal for delivery to STA-3/4.
- Storm runoff and discharges from the South Shore Drainage District, to be diverted from Lake Okeechobee to the Miami Canal for delivery to STA-3/4.

A schematic of the current design of STA-3/4 is presented in Figure 4.1

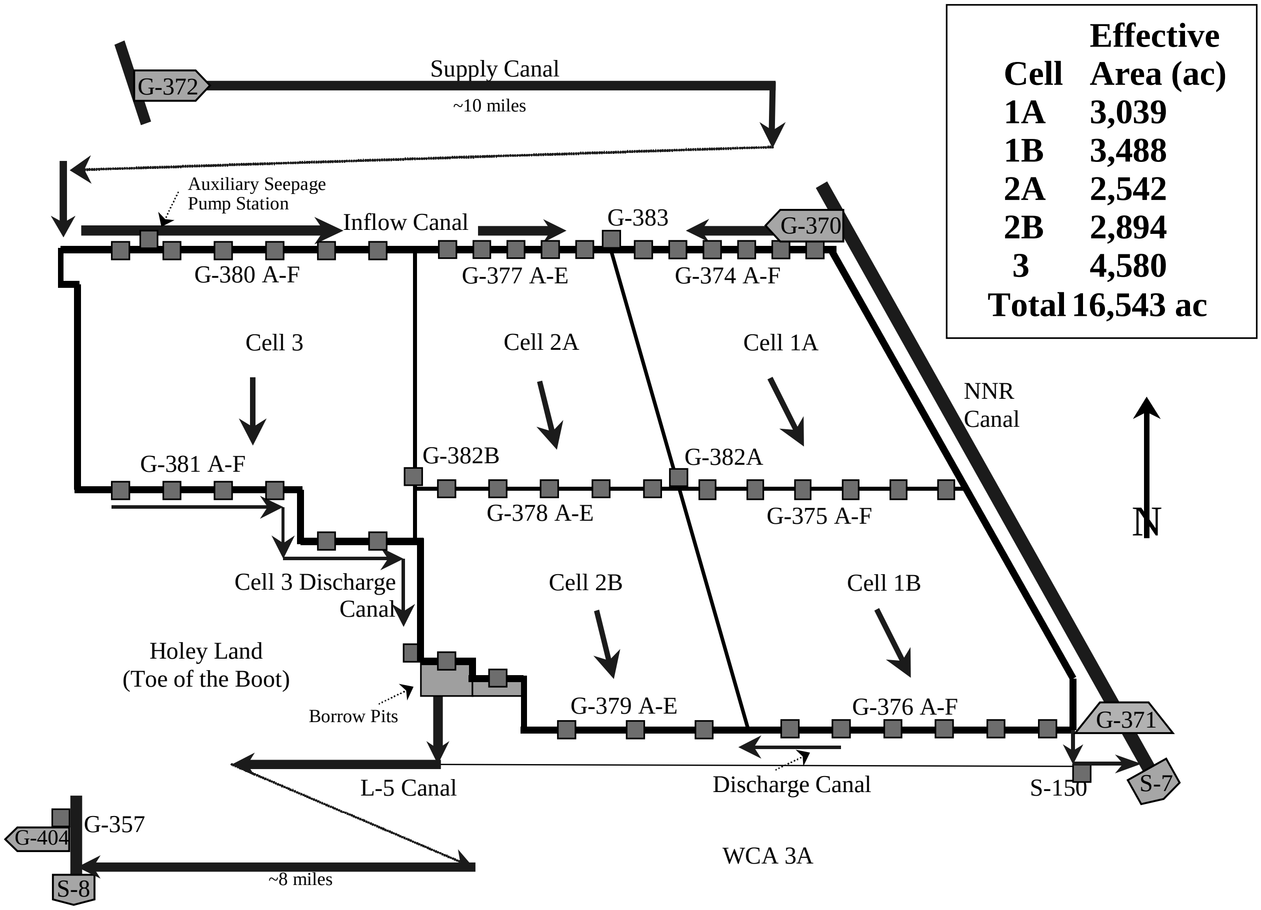


Figure 4.1. Schematic of STA-3/4

STA-3/4 is being developed as three parallel flow paths. The most easterly flow path (Cells 1A and 1B in series) is intended to treat inflows from the North New River Canal. The two westerly flow paths (Cells 2A and 2B in series, Cell 3 in parallel) are intended to treat inflows from the Miami Canal.

4.1. Existing Conditions (Baseline 2007-2014)

An analysis of Existing Conditions was prepared to assess the probable performance of STA-3/4 under regional conditions existing upon completion of the Everglades Construction Project, but prior to completion of other major initiatives (such as the Comprehensive Everglades Restoration Plan, or CERP). That analysis was prepared for a thirty-one year period, extending from 1965 through 1995, using simulated inflow volumes from the District's South Florida Water Management Model (SFWMM) and inflow total phosphorus (TP) loads developed as defined in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies.* The probable performance of STA-3/4 in reducing total phosphorus was evaluated through use of the DMSTA software, version dated March 15, 2002 (additional information on this software is presented in Part 1).

4.1.1. Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Existing Conditions for STA-3/4. Daily inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Existing Conditions are included in an Excel file "34EX_Data.xls".

Inflow Volumes and TP Loads: As presented in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies*, the estimated average annual inflows to STA-3/4 over the 31-year period are 660,889 acre-feet per year at a flow-weighted mean inflow concentration of 88 ppb (72.0 metric tons inflow TP per year). Those estimates are relatively consistent with the estimated inflows presented in the June, 2000 *Plan Formulation* for STA3/4, prepared by Burns & McDonnell (average annual inflow of 645,222 acre-feet at a flow-weighted mean inflow concentration of 85 ppb, for 50% TP load reduction in basin runoff due to BMPs in the EAA).

Daily estimates of inflow by source were taken from an Excel spreadsheet prepared by the District in connection with preparation of the *Baseline Data* (file name "sta34 inflow tp.xls" dated May 29, 2001). Table 4.1 summarizes the estimated average annual inflow volumes and total phosphorus (TP) loads and concentrations to STA-3/4 represented in those daily estimates.

Table 4.1
Estimated Inflows, 1965-1995, STA-3/4 Existing Analysis (Baseline 2007-2014)

Inflow Source and Description	**Average Annual Inflow**		**Flow-Weighted Mean TP Conc. (ppb)**
	Volume (ac-ft)	**TP Load (1,000 kg)**	
Miami Canal (S-8/S-3) Basin	187,579	23.16	100
North New River (S-7/S-2) Basin	*212,611*	*24.30*	*93*
Lake Okeechobee			
Regulatory Releases to Miami Canal	62,210	5.11	67
BMP Makeup Water to Miami Canal	65,877	5.41	67
STA Irrigation Supply to Miami Canal	547	0.04	67
Regulatory Releases to NNR Canal	*52,954*	*4.65*	*71*
BMP Makeup Water to NNR Canal	*50,685*	*4.45*	*71*
S236 Basin Diversion	10,138	1.73	138
SSDD Basin Diversion	3,569	0.44	100
C-139 Basin via G-136 and L-1E Canal	14,719	2.73	150
Total Average Annual Inflows	**660,889**	**72.02**	**88**

In the above tabulation, inflows shown in italicized text would, given the current design of STA-3/4, be introduced to the treatment area through Pumping Station G-370 and delivered to Cells 1A and 1B. Those average annual inflows aggregate to 316,250 acre-feet per year at a flow weighted mean TP concentration of 86 ppb (average annual inflow TP load of 33.4 tonnes per year). Average annual inflows to STA-3/4 from the Miami Canal via Pumping Station G-372 are estimated to aggregate 344,639 acre-feet at a flow-weighted mean inflow concentration of 91 ppb (average annual inflow TP load of 38.62 tonnes per year). For this feasibility analysis, 48% of the estimated total inflows to STA-3/4 are assigned to Cells 1A and 1B, with the remaining 52% assigned to Cells 2A, 2B and 3 (28% to Cells 2A and 2B, 24% to Cell 3).

Rainfall: For the 31-year period, daily estimates of rainfall over the surface of STA-3/4 were taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name "2050wPROJ_rfet.xls" dated March 11, 2002; worksheet identification "RF-STAs(inches)"). The average annual rainfall over the surface of STA-3/4 as reflected in that data file is estimated to be 50.68".

Evapotranspiration: Daily estimates of evapotranspiration over the surface of STA-3/4 were also taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name “2050wPROJ_rfet.xls” dated March 11, 2002; worksheet identification “ET-STAs(inches)”). The average annual evapotranspiration over the surface of STA-3/4 as reflected in that data file is estimated to be 58.27”. It should here be noted that the daily ET values were estimated as specific to the operation of STA-3/4 under the 2050 “with-CERP” simulation, and may not be fully representative of ET for the baseline condition. However, the analysis is not sensitive to minor variations in ET, and further refinement of those daily estimates is considered unnecessary for feasibility-level analyses.

4.1.2. Summary of Input Variables

The following paragraphs summarize input variables employed in the analysis of Existing Conditions for STA-3/4. Those input variables are defined in an Excel worksheet entitled “Baseline” included in the workbook “34EX_Data.xls”.

Hydraulic Properties: Depth-discharge relationships specified in the DMSTA input file for each cell of STA-3/4 were based on analysis of detailed information presented in the June 2000 *Plan Formulation* for STA-3/4. The DMSTA parameters for emergent macrophytic vegetative communities were adjusted to closely approximate the relationships developed from that source. A summary of that analysis is presented in Table 4.2. The outlet control depth in each cell was established at 40 cm (approx. 15”), consistent with the current design basis of STA-3/4.

Table 4.2 STA-3/4 Hydraulic Properties, Existing Design (Baseline 2007-2014)

Cell	Mean Ground Elev.(ft. NGVD)	Discharge (cfs)	Discharge (hm*3/d)	Ave. Cell Width (km)	Mean Stage (ft. NGVD)	Mean Depth (ft)	Depth (m)	Coeff. A (m)	Exp. B	Computed Discharge (hm*3/d)	Ratio, Comp. Q/Target
1A	9.35	398	0.974	3.419	11.70	2.35	0.716	0.68	2.45	1.027	1.05
	9.35	990	2.422	3.419	12.57	3.22	0.981	0.68	2.45	2.221	0.92
	9.35	1,580	3.866	3.419	13.35	4.00	1.219	0.68	2.45	3.778	0.98
	9.35	2,170	5.309	3.419	14.10	4.75	1.448	0.68	2.45	5.756	1.08
1B	9.25	398	0.974	4.496	11.35	2.10	0.640	0.77	2.9	0.949	0.97
	9.25	990	2.422	4.496	12.17	2.92	0.890	0.77	2.9	2.469	1.02
	9.25	1,580	3.866	4.496	12.60	3.35	1.021	0.77	2.9	3.678	0.95
	9.25	2,170	5.309	4.496	13.05	3.80	1.158	0.77	2.9	5.301	1.00
2A	9.70	263	0.643	2.885	11.65	1.95	0.594	0.85	2.6	0.634	0.99
	9.70	840	2.055	2.885	12.74	3.04	0.927	0.85	2.6	2.011	0.98
	9.70	1,410	3.450	2.885	13.45	3.75	1.143	0.85	2.6	3.471	1.01
	9.70	1,980	4.844	2.885	13.95	4.25	1.295	0.85	2.6	4.806	0.99
2B	9.70	263	0.643	4.023	11.50	1.80	0.549	1.05	3	0.698	1.08
	9.70	840	2.055	4.023	12.23	2.53	0.771	1.05	3	1.937	0.94
	9.70	1,410	3.450	4.023	12.75	3.05	0.930	1.05	3	3.394	0.98
	9.70	1,980	4.844	4.023	13.20	3.50	1.067	1.05	3	5.129	1.06
3	9.60	224	0.548	4.877	11.18	1.58	0.482	0.52	2.1	0.547	1.00
	9.60	710	1.737	4.877	12.32	2.72	0.829	0.52	2.1	1.711	0.98
	9.60	1,200	2.936	4.877	13.10	3.50	1.067	0.52	2.1	2.905	0.99
	9.60	1,690	4.135	4.877	13.87	4.27	1.302	0.52	2.1	4.411	1.07

Seepage: Generalized estimates of seepage losses from STA-3/4 were taken from information presented in Part 9 of the June 2000 *Plan Formulation* for STA-3/4, Burns & McDonnell, and are based on Scenario 2 as presented therein (all recoverable seepage returned to the treatment area). As presented in that reference, seepage losses along the Supply Canal and the northern boundary of the treatment area represent a significant proportion of the overall inflow volume. Combining information contained in Tables 9.6 and 9.9 of the *Plan Formulation*, it can be seen that net inflows to the treatment area over the 31-year period of simulation aggregate to but 84% of the pumped inflow volumes at G-370 and G-372. However, that reference is silent on the eventual fate of the deep seepage losses, the bulk of which would be delivered to agricultural lands to the north of the treatment area. For this analysis, it is assumed that those deep losses to the north would result in increased pumping from the adjacent agricultural lands (not reflected in the SFWMM simulation), with the result that they would eventually be returned to the treatment area. <u>No adjustment to inflow volumes and loads for seepage losses "upstream" of the treatment area are made in this analysis</u>.

A summary of the seepage losses and estimated recoveries from the various cells of STA-3/4, based on the information presented in the Plan Formulation, is presented in Table 4.3.

Table 4.3 Estimated Seepage Loss Rates and Recovery from STA-3/4

Cell	Location	Length (ft)	Rate (cf/d/ft/ft))	Total Seepage (cf/day/ft)	Cell Area (ac)	Loss Rate (ft/d/ft)	Loss Rate (m/yr/m)	% Recovery
1A	North Line	9,000	21.2	190,800	3,039	0.00144	0.526	46
	East Line	14,500	39.6	574,200	3,039	0.00434	1.583	52
	Total	(Similar control elevation both locations)				0.00578	2.109	51
1B	East Line	11,000	39.6	435,600	3,488	0.00287	1.046	52
2A	North Line	7,200	21.2	152,640	2,542	0.00138	0.503	46
2B	West Line	6,500	18.3	118,950	2,894	0.00094	0.344	0
3	North Line	17,000	21.2	360,400	4,580	0.00181	0.659	46
	West Line	13,000	18.3	237,900	4,580	0.00119	0.435	0

Cell	Location	Ave. Grade (ft. NGVD)	Control Elev. (ft. NGVD)	Relative to Ave. Grade (ft)	Relative to Ave. Grade (cm)	Remarks
1A	North Line	9.35	7.5	-1.85	-56	
	East Line	9.35	7.5	-1.85	-56	
2A	North Line	9.70	7.5	-2.2	-67	
2B	West Line	9.70	11.4	1.7	52	Approx. Ave. Elev. In Holey Land
3	North Line	9.60	7.5	-2.1	-64	
3	West Line	9.60	11.4	1.8	55	Approx. Ave. Elev. In Holey Land

As presented in the *Plan Formulation*, estimated seepage losses from Cell 2B are nominal in nature, and are generally offset by seepage inflows from the Holey Land Wildlife Management Area. In this analysis, no seepage losses from Cell 2B are considered. In addition, a limitation of the DMSTA model is that all recovered seepage losses, when returned to the treatment area, are returned to the cell from which they occur. The design of STA-3/4 is developed to return all recovered seepage from the north and east lines of the treatment area to the upstream end of Cell 1A. That condition cannot be represented in the DMSTA analysis.

Treatment Parameters: As presently designed, STA-3/4 is intended to consist entirely of emergent macrohpytic marsh. Default values in the DMSTA model for Emergent communities were employed in the analysis of existing conditions.

No. of CSTRs in Series: The design of STA-3/4 is developed to maximize the extent to which uniform flow distribution can be developed in each cell. For analysis of existing conditions, a total of three Continuous Stirred Tank Reactors (CSTRs) in series was assigned in each cell, other than as follows. In cells 1A, 2A and 3, the design of STA-3/4 includes three canals extending across the full width of the cell transverse to the primary flow direction. The presence of those transverse deep zones can be expected to improve overall flow patterns through flow redistribution. In those cells, the number of CSTRs in series was increased by one for each transverse canal, yielding a total of six CSTRs in series in those three cells.

4.1.3. Results of DMSTA Analysis for Existing Conditions (Baseline 2007-2014)

A detailed listing of input variables employed in the analysis of Existing Conditions for STA-3/4, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 4.5 (which consists of screen information taken directly from the DMSTA output file).

A condensed summary of the results of the analysis is presented in Table 4.4.

Table 4.4 Discharge Summary, STA-3/4 Existing Conditions (Baseline 2007-2014)

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	769.3
Average Annual Outflow Volume	Ac-ft/yr	623,700
Average Annual Outflow TP Load	Kg/yr	28,013.8
Flow-weighted Mean TP Concentration	ppb	36
Geometric Mean TP Concentration, weekly composites	ppb	36

Table 4.5 Results of DMSTA Analysis, STA-3/4 Existing Design (Baseline 2007-2014)

Case Description: Existing, 100% Emergent

Filename: 34EX_Data.xls

Input Variable	Units	Value
Design Case Name	-	Baseline
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.1%
Flow-Wtd Conc - With Bypass	ppb	36.4
Flow-Wtd Conc - Without Bypass	ppb	36.4
Geometric Mean Conc	ppb	35.9
95th Percentile Conc	ppb	46.5
Freq Cell Outflow > 10 ppb	%	100%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3	
Vegetation Type	------->	EMERG	EMERG	EMERG	EMERG	EMERG	
Inflow Fraction	-	0.48	0	0.28	0	0.24	
Downstream Cell Number	-	2	0	4	0	0	
Surface Area	km2	12.298	14.115	10.287	11.712	18.535	
Mean Width of Flow Path	km	3.42	4.50	2.89	4.02	4.88	
Number of Tanks in Series	-	6	3	6	3	6	
Outflow Control Depth	cm	40	40	40	40	40	
Outflow Coefficient - Exponent	-	2.45	2.9	2.6	3	2.1	
Outflow Coefficient - Intercept	-	0.68	0.77	0.85	1.05	0.52	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0.0058	0.0029	0.0014	0	0.0018	
Outflow Seepage Control Elev	cm	-56	-56	-67	0	-64	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0.51	0.52	0.46	0	0.46	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*15.66*	*15.66*	*15.66*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	12.07	18.49	30.13	36.20	47.78		47.78
Run Date	-	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02		04/17/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95		12/31/95
Output Duration	days	11322	11322	11322	11322	11322		11322
Cell Label		1A	1B	2A	2B	3		Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	Outflow		-
Surface Area	km2	12.298	14.115	10.287	11.712	18.535		66.9
Mean Water Load	cm/d	8.7	7.3	6.1	5.2	2.9		3.3
Max Water Load	cm/d	48.2	40.0	33.6	28.4	16.0		18.4
Inflow Volume	hm3/yr	391.6	374.2	228.4	223.0	195.8		815.9
Inflow Load	kg/yr	34595.0	22124.1	20180.4	11853.5	17297.5		72073.0
Inflow Conc	ppb	88.3	59.1	88.3	53.1	88.3		88.3
Treated Outflow Volume	hm3/yr	374.2	363.5	223.0	220.8	185.0		769.3
Treated Outflow Load	kg/yr	22124.1	14288.4	11853.5	7242.5	6482.8		28013.8
Treated FWM Outflow Conc	ppb	59.1	39.3	53.1	32.8	35.0		36.4
Total FWM Outflow Conc	ppb	59.1	39.3	53.1	32.8	35.0		36.4
Surface Outflow Load Reduc	%	36.0%	35.4%	41.3%	38.9%	62.5%		61.1%
Outflow Geometric Mean - Daily	ppb	58.3	37.7	53.7	32.4	35.6		35.8
Outflow Geo Mean - Composites	ppb	58.8	37.9	54.0	32.5	35.7		35.9
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	100%		100%

4.2. Baseline 2015-2056 Conditions

Basins tributary to STA-3/4 are scheduled to receive certain component projects of the Comprehensive Everglades Restoration Program (CERP). The most significant of these is the component entitled “EAA Storage Reservoir, Phase 1 . That project was authorized in the Water Resources Development Act (WRDA) of 2000, and is presently scheduled for completion in September 2009. The full CERP Simulation (2050wPROJ) prepared for the feasibility studies includes Phase 1 and 2 of the EAA Storage Reservoir Project with Phase 2 to be completed by 2014. As a result, Baseline 2015-2056 conditions should properly be considered as those which will result from implementation of the EAA Storage Reservoir Phase 1 and 2 project, and other elements of CERP which may substantially influence inflows to both STA-3/4 and the EAA Storage Reservoir. For this analysis, Existing conditions (Baseline 2007-2014) are assigned to the period 8-year period 2007-2014, and Baseline 2015-2056 conditions to the 42-year period 2015-2056.

The October 30, 2001 draft of *Preliminary Alternative Combinations for the ECP Basins* postulates that, after the EAA Storage Reservoir Project becomes operational, there will be peak flow attenuation and some flow reduction into STA-3/4, and that there will also be a reduction in inflow TP loads to STA-3/4. The anticipated net effect of those modifications to inflow volumes and loads was projected to be an improved water quality performance in STA-3/4.

4.2.1. Influence of EAA Storage Reservoir Phase 1 and 2 Project

The EAA Storage Reservoirs concept referenced in this report is based on a South Florida Water Management Model simulation (2050wPROJ) which was performed specifically for the evaluation of alternatives during the conduct of the Basin-Specific Feasibility Studies. This simulation, which includes both Phase 1 and Phase 2 of the EAA Storage Reservoirs project, includes assumptions which may or may not be consistent with the CERP project goals and assumptions. The Project Delivery Team will perform regional modeling in support of the PIR development and selection of the recommended plan for the EAA Storage Reservoir Phase 1 project. Close coordination between the EAA

Storage Reservoir Project and the Basin-Specific Feasibility Study project is necessary in order to ensure the goals of both projects are met.

The EAA Storage Reservoir Phase 1 and 2 project as formulated in the 2050wPROJ simulation includes a total of four compartments, the operation of three of which were simulated to impact inflow volumes and TP loads to STA-3/4. Two of those three compartments (A1 and A2) were simulated to be situated north of STA-3/4, generally between the North New River (NNR) and Miami canals. The third compartment (Compartment B) was simulated to be situated east of the North New River Canal adjacent to STA-2. The balance of this analysis of the influence of the EAA Storage Reservoir Phase 1 and 2 project on inflow volumes and TP loads to STA-3/4 is based on the project formulation and operation reflected in the District's South Florida Water Management Model (2050wPROJ) run for conditions in 2050 following full implementation of CERP.

Compartment A1 was simulated to receive runoff from the NNR and Miami canal basins. Outflows from Compartment A1 was simulated to consist primarily of irrigation supply to the NNR and Miami canal basins. In addition, overflows from Compartment A1 were simulated to be directed to Compartment A2.

Compartment A2 was simulated to receive, in addition to those overflows from A1, regulatory releases from Lake Okeechobee, intended for use in satisfying environmental water supply demands. Outflows from Compartment A2 were simulated to be directed primarily to STA-3/4, and to consist of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface). In addition to those outflows, overflows from Compartment A2 were simulated to be directed to Compartment B.

Compartment B was simulated to receive, in addition to those overflows from A2, regulatory releases from Lake Okeechobee, also intended for use in satisfying environmental water supply demands. All outflows from Compartment B were simulated to be directed to STA-3/4, and to consist of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface).

A schematic of the fluxes to and from Compartments A1, A2 and B of the EAA Storage Reservoir Phase 1 and 2 project is presented in Figure 4.2.

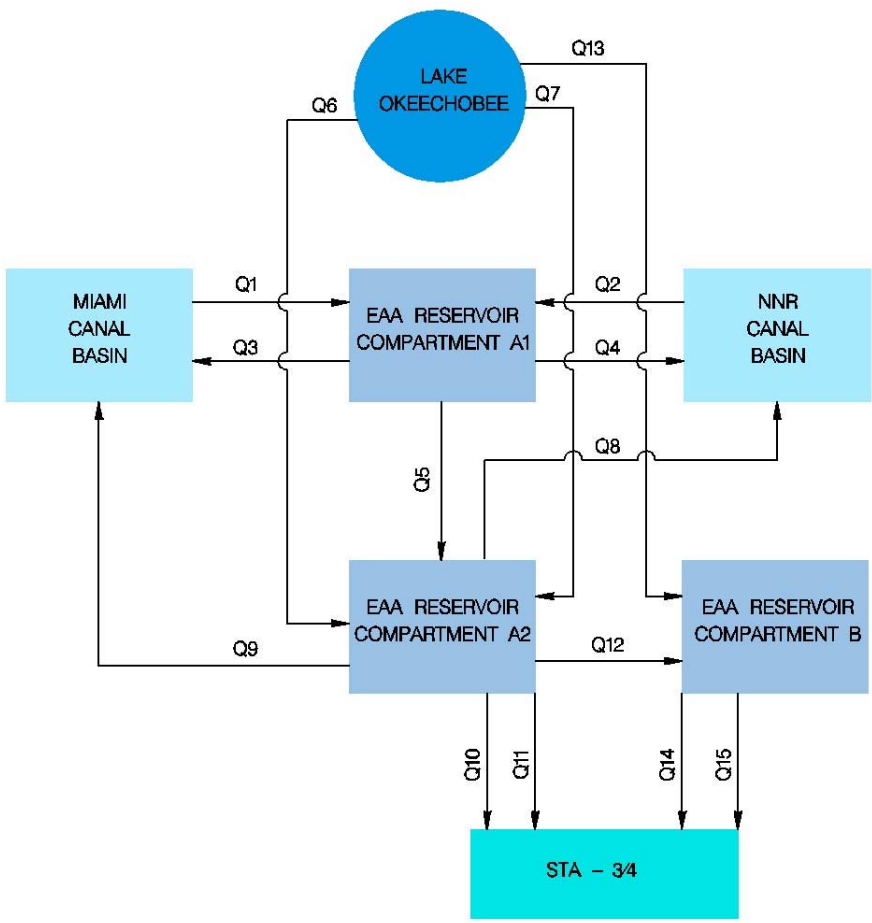


Figure 4.2 EAA Storage Reservoir Phase 1 and 2 Flow Schematic Vicinity STA-3/4

The areas of Compartments A1, A2, and B were originally modeled in this analysis based on the number of grid cells in the SFWMM as 20,400 acres, 20,400 acres, and 10,240 acres was used in this study; a subsequent memo (Pro ECP 15, by SFWMD HSM WSD dated April 15, 2002) stated each compartment as 20,000 acres, 21,500 acres, and 9,500 acres, respectively. This small area difference produced a negligible change in phosphorus removal capability (from 0.0 to 0.4 ppb difference in reservoir outflow) of each compartment. Given the minor impact on the analysis, particularly in light of the approximate nature of the reservoir analyses, it was considered acceptable to continue with the original results of the analysis. A summary of the average annual transfer volumes and TP loads between the various reservoir compartments and STA-3/4 is presented in Table 4.6.

Table 4.6 Average Annual Inflows and Outflows, EAA Storage Reservoir Phase 1 and 2 Vicinity STA-3/4

Flow Ident.	Description	Ave. Annual Inflow		
		Volume (acre-feet)	TP Load (kg)	TP Conc. (ppb)
Q1	Miami Canal Basin Runoff	79,756	9,405	96
Q2	NNR Canal Basin Runoff	95,021	11,012	94
	Total Compartment A1 Inflows	174,777	20,417	95
Q3	Miami Canal Basin Irrigation from A1	68,632	5,175	61
Q4	NNR Canal Basin Irrigation from A1	77,883	5,752	60
Q5	Overflow, Compartment A1 to A2	13,424	1,524	92
	Total Compartment A1 Outflows	159,939	12,451	63
Q6	Lake Regulatory Release to A2, Miami Canal	88,779	7,295	67
Q7	Lake Regulatory Release to A2, NNR Canal	25,558	2,246	71
	Total Compartment A2 Inflows	127,761	11,065	70
Q8	NNR Canal Basin Irrigation from A2	2,800	184	53
Q9	Miami Canal Basin Irrigation from A2	2,179	109	41
Q10	STA-3/4 Inflow from A2, Surface	77,965	5,189	54
Q11	STA-3/4 Inflow from A2, Subsurface	4,226	104	20
Q12	Overflow, Compartment A2 to B	25,663	2,147	68
	Total Compartment A2 Outflows	112,833	7,733	56
Q13	Lake Regulatory Release to B, NNR Canal	128,358	11,278	71
	Total Compartment B Inflows	154,021	13,425	71
Q14	STA-3/4 Inflow from B, Surface	140,420	9,549	55
Q15	STA-3/4 Inflow from B, Subsurface	5,516	136	20
	Total Compartment B Outflows	145,936	9,685	54
	Total STA-3/4 Inflows from EAA Reservoirs	228,127	14,978	53

The following paragraphs define the source of data summarized in Table 4.6.

Hydrologic Data: Daily reservoir inflow and outflow volumes for the 31-year period of simulation 1965-1995 are taken from the following Excel files furnished by the District:

- A1in.xls, dated March 5, 2002.
- A1out.xls, dated March 5, 2002.
- A2in.xls, dated March 5, 2002.
- A2ot.xls, dated March 5, 2002.
- Bin.xls, dated March 5, 2002.
- Bout.xls, dated March 4, 2002.

Those files also include estimated daily inflow TP loads by source, other than for discharges from the compartments (subsequently discussed herein). Daily rainfall and evapotranspiration in Compartments A1 and A2 were assigned at the values employed for the existing conditions analysis of STA-3/4. Daily rainfall and evapotranspiration in Compartment B were assigned at the values employed for the existing conditions analysis of STA-2. Daily stages in each compartment of the reservoir were taken from another District-furnished Excel file ("EAAres_daily_stages.xls", dated February 15, 2002).

TP Loads: As noted above, daily estimates of TP inflow loads to the various reservoir compartments (other than overflows from one compartment to another) were taken from the District-furnished Excel files. For this analysis, it was necessary to estimate TP reductions in the various reservoir compartments in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir compartments, including both overflows from one compartment to another, and releases to STA-3/4. Those estimates were developed on the <u>assumption</u> that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoirs was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates in each compartment were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. Summaries of the long-term estimates of TP reduction in the various compartments are presented in Tables 4.7, 4.8 and 4.9 for compartments A1, A2 and B, respectively.

The estimated performance the EAA Storage Reservoir compartments in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 4.7 Estimated Long-Term Average Outflow Concentration, Compartment A1

Mean Depth in Reservoir (m)	(For wet period fraction)					**1.168**
Approx. Basin Area (acres)						**20,400**
Approx. Basin Area (sq.m.)						**82,556,148**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)					
Input Parameters			**Estimated TP Removal**			
Average Inlet Concentration	mg/l	0.0947	q	2.406		
Average Annual Inflow Volume	ac/ft	174,777	K	0.025		
Average Annual Inflow Volume	cu.m.	215,586,000	P	117	ppb	
Average Annual Rainfall	m	1.287	N	1.422		
Average Annual Evapotranspiration	m	1.456		2.586		
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.026	R	0.442		
Infiltration from Groundwater	m/yr	0.000	Pout	65	ppb	
Water Balance Adjustment & Exfiltration	m/yr	0.016	Pout	0.0651	mg/l	
Change in Storage	m./yr.	0.036	REF:	*Phosphorus Removal by Urban Runoff*		
Ave. TP Conc. In Seepage Inflows	mg/l	0.000		*Detention Basins;* Lake and Reservoir		
Wet Period Fraction		0.964		Management, Volume 3; North American		
				Lake Management Society; 1987		
SUMMARY OF RESULTS						
Reservoir Area	acres	20,400				
Ave. Annual Outflow Volume	cu.m.	197,283,137				
Ave. Annual Outflow Volume	ac-ft	159,939		Surface Discharges Only		
Mean TP Conc. In Outflows	mg/l	0.0651				

Table 4.8 Estimated Long-Term Average Outflow Concentration, Compartment A2

Mean Depth in Reservoir (m)	(For wet period fraction)					**0.983**
Approx. Basin Area (acres)						**20,400**
Approx. Basin Area (sq.m.)						**82,556,148**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)					
Input Parameters			**Estimated TP Removal**			
Average Inlet Concentration	mg/l	0.0721	q	1.823		
Average Annual Inflow Volume	ac/ft	127,761	K	0.018		
Average Annual Inflow Volume	cu.m.	157,592,272	P	94	ppb	
Average Annual Rainfall	m	1.287	N	0.920		
Average Annual Evapotranspiration	m	1.303		2.163		
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.026	R	0.368		
Infiltration from Groundwater	m/yr	0.000	Pout	59	ppb	
Water Balance Adjustment & Exfiltration	m/yr	0.200	Pout	0.0594	mg/l	
Change in Storage	m./yr.	0.070	REF:	*Phosphorus Removal by Urban Runoff Detention Basins;* Lake and Reservoir Management, Volume 3; North American Lake Management Society; 1987		
Ave. TP Conc. In Seepage Inflows	mg/l	0.000				
Wet Period Fraction		0.887				
SUMMARY OF RESULTS						
Reservoir Area	acres	20,400				
Ave. Annual Outflow Volume	cu.m.	133,965,784				
Ave. Annual Outflow Volume	ac-ft	108,607		Surface Discharges Only		
Mean TP Conc. In Outflows	mg/l	0.0594				

Table 4.9 Estimated Long-Term Average Outflow Concentration, Compartment B

Mean Depth in Reservoir (m)	(For wet period fraction)					**0.682**
Approx. Basin Area (acres)						**10,240**
Approx. Basin Area (sq.m.)						**41,439,949**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)					
Input Parameters			**Estimated TP Removal**			
Average Inlet Concentration	mg/l	0.0707	q	4.824		
Average Annual Inflow Volume	ac/ft	154,021	K	0.032		
Average Annual Inflow Volume	cu.m.	189,983,513	P	74	ppb	
Average Annual Rainfall	m	1.303	N	0.333		
Average Annual Evapotranspiration	m	1.009		1.526		
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.0253	R	0.208		
Infiltration from Groundwater	m/yr	0.000	Pout	59	ppb	
Water Balance Adjustment & Exfiltration	m/yr	0.644	Pout	0.0586	mg/l	
Change in Storage	m./yr.	0.055	REF:	*Phosphorus Removal by Urban Runoff Detention Basins;* Lake and Reservoir Management, Volume 3; North American Lake Management Society; 1987		
Ave. TP Conc. In Seepage Inflows	mg/l	0.000				
Wet Period Fraction		0.703				
SUMMARY OF RESULTS						
Reservoir Area	acres	10,240				
Ave. Annual Outflow Volume	cu.m.	173,206,550				
Ave. Annual Outflow Volume	ac-ft	140,420		Surface Discharges Only		
Mean TP Conc. In Outflows	mg/l	0.0586				

In the above analyses,

- Average annual evapotranspiration was limited to that occurring with stages above the ground surface.
- The TP concentration in rainfall was assigned at 10 ppb attached to rainfall, plus a dry fall of 20 mg/m^2-yr.
- The term "Water Balance Adjustment and Exfiltration" includes both directly estimated seepage losses and outflows from the reservoir (evapotranspiration and subsurface discharges) on days when the reservoir stage is at or below the ground surface.
- The wet period fraction was taken as the number of days over the 31-year period of simulation when the reservoir stage was above ground surface divided by the total number of days in the simulation.
- The mean depth was computed as the average depth of the reservoir on days when the reservoir stage was above the ground surface.

The daily simulations of Compartments A1, A2 and B are contained in separately furnished Excel files "Compartment A1 Base.xls", "Compartment A2 Base.xls", and "Compartment B Base.xls", respectively.

Subsurface discharges from Compartments A2 and B to STA-3/4 were considered as analogous to seepage outflows, and were assigned a mean TP concentration of 20 ppb.

4.2.2. STA-3/4 Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Baseline 2015-2056 Conditions for STA-3/4. Daily inflow rates, TP concentrations, rainfall and evaportranspiration employed in the DMSTA analysis of that condition are included in an Excel file "34FU_Data.xls".

Inflow Volumes and TP Loads: Daily inflow volumes to STA-3/4 were taken from a District-furnished Excel file ("sta34in.xls" dated March 7, 2002). Daily inflow TP concentrations by source (other than inflows from the EAA Storage Reservoir compartments) were assigned at values equal to those used in analysis of existing conditions at STA-3/4. Daily TP concentrations and loads in inflows from compartments A2 and B of the EAA Storage Reservoir Phase 1 and 2 were taken from the simulations discussed above. A summary of the estimated average annual inflow volumes and loads to STA-3/4 under the Baseline 2015-2056 condition is presented in Table 4.10.

Table 4.10
Estimated Inflows, 1965-1995, STA-3/4 Baseline 2015-2056 Analysis

Inflow Source and Description	**Average Annual Inflow**		**Flow-Weighted Mean TP Conc. (ppb)**
	Volume (ac-ft)	**TP Load (kg)**	
Miami Canal (S-8/S-3) Basin	98,915	12,504	103
North New River (S-7/S-2) Basin	99,004	11,788	97
Lake Okeechobee			
Regulatory Releases to Miami Canal	36,200	2,975	67
BMP Makeup Water to Miami Canal	46,814	3,847	67
STA Irrigation Supply to Miami Canal	42	4	67
Regulatory Releases to NNR Canal	61,768	5,427	71
BMP Makeup Water to NNR Canal	30,502	2,680	71
S236 Basin Diversion	11,075	1,858	136
SSDD Basin Diversion	4,851	598	100
C-139 Basin via G-136 and L-1E Canal	11,203	1,939	140
EAA Storage Reservoir Comp. A2, Surface	77,965	5,189	54
EAA Storage Reservoir Comp. A2, Subsurface	4,226	104	20
EAA Storage Reservoir Comp. B, Surface	140,420	9,549	55
EAA Storage Reservoir Comp. B, Subsurface	5,517	136	20
Total Average Annual Inflows	**628,502**	**58,598**	**76**

Estimated average annual inflow volumes and TP loads to STA-3/4 under Baseline 2015-2056 condition are reduced 4.9% and 18.6%, respectively, from those estimated for Existing Conditions (Baseline 2007-2015).

Daily Rainfall and Evapotranspiration were assigned equal to those reflected in the analysis of Existing Conditions for STA-3/4.

4.2.3. Summary of Input Variables

All input variables for analysis of the Baseline 2015-2056 Condition at STA-3/4 were assigned at values identical to those employed in the Existing Conditions (Baseline 2007-2014) analysis for STA-3/4. Those input variables are defined in an Excel worksheet entitled "Baseline 2015-2056" included in the workbook "34FU_xls".

4.2.4. Results of DMSTA Analysis for Baseline 2015-2056

A detailed listing of input variables employed in the analysis of the Baseline 2015-2056 Condition for STA-3/4, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 4.11 (which consists of screen information taken directly from the DMSTA output files).

Table 4.11 Results of DMSTA Analysis, Baseline 2015-2056 STA-3/4 Design

Input Variable	Units	Value	Case Description:	Filename:	34FU_Data.xls
Design Case Name	-	Future	No project, with reservoir, 100% emergent		
Starting Date for Simulation	-	01/00/00			
Ending Date for Simulation	-	01/00/00			
Starting Date for Output	-	01/00/00			

Input Variable	Units	Value	Output Variable	Units	Value
Steps Per Day	-	3	Water Balance Error	%	0.0%
Number of Iterations	-	2	Mass Balance Error	%	0.1%
Output Averaging Interval	days	7	Flow-Wtd Conc - With Bypass	ppb	32.0
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - Without Bypass	ppb	32.0
Max Inflow / Mean Inflow	-	0	Geometric Mean Conc	ppb	30.4
Max Reservoir Storage	hm3	0	95th Percentile Conc	ppb	40.9
Reservoir P Decay Rate	1/yr/ppb	0	Freq Cell Outflow > 10 ppb	%	100%
Rainfall P Conc	ppb	10	Bypass Load	%	0.0%
Atmospheric P Load (Dry)	mg/m2-yr	20			

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3	
Vegetation Type	------->	EMERG	EMERG	EMERG	EMERG	EMERG	
Inflow Fraction	-	0.48	0	0.28	0	0.24	
Downstream Cell Number	-	2	0	4	0	0	
Surface Area	km2	12.298	14.115	10.287	11.712	18.535	
Mean Width of Flow Path	km	3.42	4.50	2.89	4.02	4.88	
Number of Tanks in Series	-	6	3	6	3	6	
Outflow Control Depth	cm	40	40	40	40	40	
Outflow Coefficient - Exponent	-	2.45	2.9	2.6	3	2.1	
Outflow Coefficient - Intercept	-	0.68	0.77	0.85	1.05	0.52	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0.0058	0.0029	0.0014	0	0.0027	
Outflow Seepage Control Elev	cm	-56	-56	-67	0	-64	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0.51	0.52	0.46	0	0.46	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*15.66*	*15.66*	*15.66*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	12.32	18.45	30.03	36.20	47.84		47.84
Run Date	-	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02		04/17/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95		12/31/95
Output Duration	days	11322	11322	11322	11322	11322		11322
Cell Label		1A	1B	2A	2B	3		Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	Outflow		-
Surface Area	km2	12.298	14.115	10.287	11.712	18.535		66.9
Mean Water Load	cm/d	8.3	6.9	5.8	5.0	2.7		3.2
Max Water Load	cm/d	47.7	38.7	33.3	27.6	15.8		18.3
Inflow Volume	hm3/yr	372.4	355.0	217.3	211.8	186.2		775.9
Inflow Load	kg/yr	28148.0	18148.8	16419.7	9689.0	14074.0		58641.8
Inflow Conc	ppb	75.6	51.1	75.6	45.7	75.6		75.6
Treated Outflow Volume	hm3/yr	355.0	344.2	211.8	209.6	171.7		725.4
Treated Outflow Load	kg/yr	18148.8	11892.4	9689.0	6029.0	5271.8		23193.2
Treated FWM Outflow Conc	ppb	51.1	34.6	45.7	28.8	30.7		32.0
Total FWM Outflow Conc	ppb	51.1	34.6	45.7	28.8	30.7		32.0
Surface Outflow Load Reduc	%	35.5%	34.5%	41.0%	37.8%	62.5%		60.4%
Outflow Geometric Mean - Daily	ppb	49.2	32.0	44.3	27.1	29.7		30.2
Outflow Geo Mean - Composites	ppb	49.7	32.4	44.7	27.2	29.9		30.4
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	100%		100%

A condensed summary of the results of the analysis is presented in Table 4.12.

Table 4.12 Discharge Summary, STA-3/4 Baseline 2015-2056 Design

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	725.4
Average Annual Outflow Volume	Ac-ft/yr	588,100
Average Annual Outflow TP Load	Kg/yr	23,193.2
Flow-weighted Mean TP Concentration	ppb	32
Geometric Mean TP Concentration, weekly composites	ppb	30

Estimated average annual outflow volumes and TP loads from STA-3/4 under the Baseline 2015-2056 condition are reduced 5.7% and 17.2%, respectively, from those estimated for Existing Conditions (Baseline 2007-2014).

4.3. Baseline Condition for Evaluation of Alternatives

The Evaluation Methodology requires a comparison of the performance of various alternatives for improved treatment performance in STA-3/4 to a Baseline condition. The Baseline condition at STA-3/4 consists of a combination of Existing Conditions (Baseline 2007-2014) and the Baseline 2015-2056 Conditions. The performance of STA-3/4 under Existing conditions is applied to the period 2007-2014 (8 years). The performance of STA-3/4 under Baseline (2015-2056) conditions is applied to the period 2015-2056 (42 years). Table 4.13 presents a summary of the Baseline discharges from STA-3/4 against which discharges from the various alternatives will be evaluated.

Table 4.13 STA-3/4 Baseline Total Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	623,700	28,013.8	4,989,600	224,110
2015	2056	588,100	23,193.2	24,700,200	974,114
2007	**2056**	**593,800**	**24,474.0**	**29,689,800**	**1,198,224**
Flow-weighted mean TP Concentration in Discharges, ppb					**33**

4.4. Alternative No. 1

Under Alternative No. 1, STA-3/4 would be modified to optimize its performance, with completion of all modifications and placement into service of the modified treatment area occurring in 2014. For this analysis, that optimization is considered to consist of the conversion of Cells 1B and 2B from emergent vegetation to Submerged Aquatic Vegetation (SAV). In addition, the downstream 2,427 acres (53%) of Cell 3 would also be converted to SAV.

A schematic of STA-3/4, under Alternative 1 is presented in Figure 4.3.

4.4.1. Treatment Analysis Input Data Summary

As this alternative is considered as complete in 2014, inflows to the modified treatment area would be consistent with those projected for the Baseline 2015-2056 condition (e.g., estimated inflows following completion of the EAA Storage Reservoir, Phase 1 and 2). Accordingly, inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 1 are taken from the “34FU_Data.xls” Excel file. Inflow volumes and TP loads are identical to those summarized in Table 4.10.

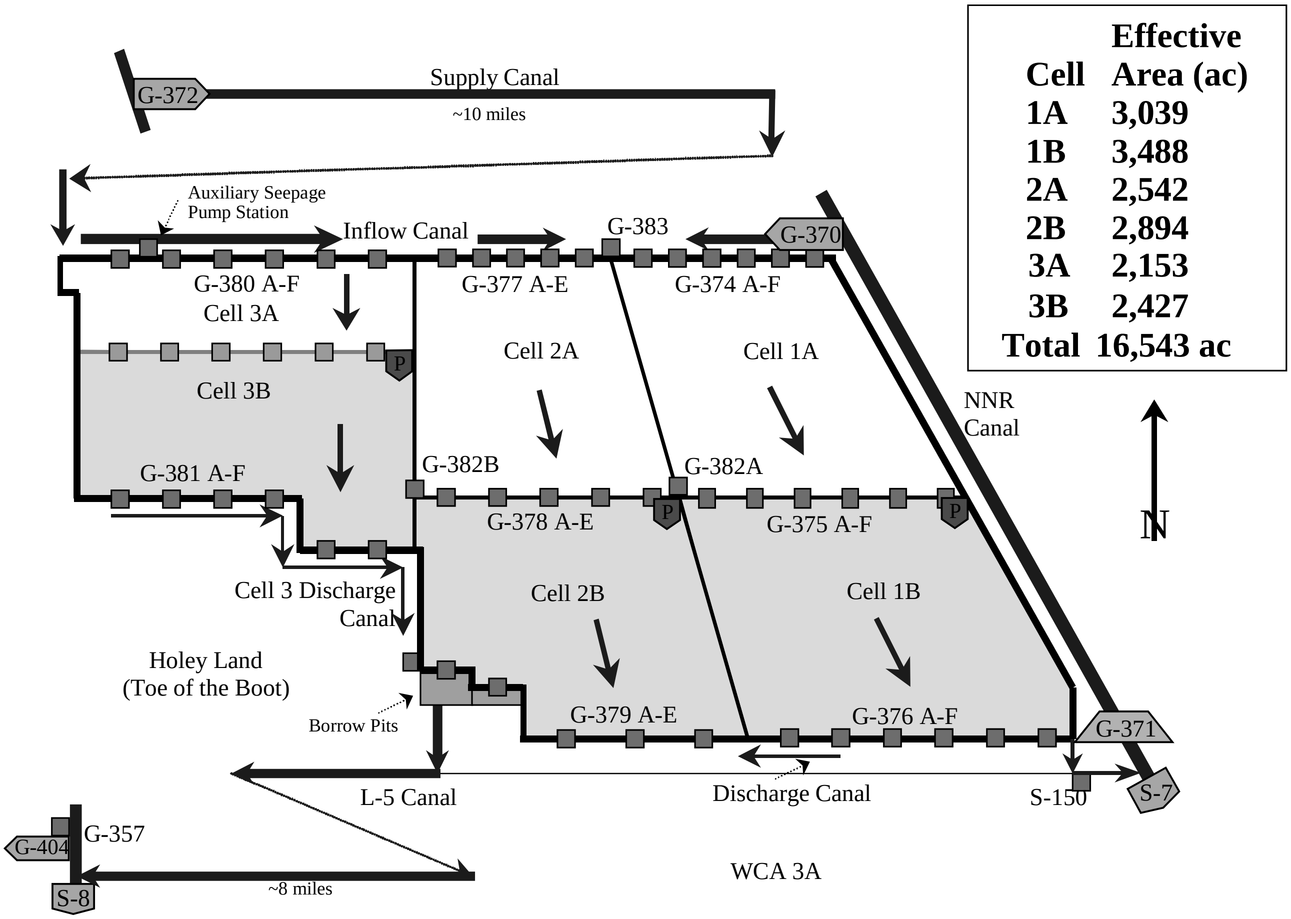


Figure 4.3. Schematic of STA-3/4, under Alternative 1

4.4.2. Summary of Input Variables for Treatment Analysis

Other than as discussed below, input variables employed in the analysis of Alternative 1 for STA-3/4 are identical to those included in the Baseline 2015-2056 Condition analysis.

- Cell 3 was subdivided into two cells, Cell 3A (2,153 acres) and Cell 3B (2,427 acres).
- The Outflow Control Depth in Cells 1B, 2B and 3B was modified from 40 cm to 60 cm.

- The vegetation type in Cells 1B, 2B and 3B was revised from “Emergent” to “SAV_C4”, and the associated default treatment parameters of DMSTA were employed in the analysis.
- Given the subdivision of Cell 3, the number of CSTRs in series was established at 4 in Cell 3A and 4 in Cell 3B, as each would be traversed by one deep zone (the division between the two cells is anticipated to be established at or very near the third transverse canal in Cell 3 as presently designed).
- The seepage transfer rate in Cell 3A was increased to closely approximate the total transfer rate from Cell 3 of the previous analyses, and the seepage transfer rate from Cell 3B was set at zero.

4.4.3. Results of DMSTA Analysis for Alternative 1

A detailed listing of input variables employed in the analysis of Alternative 1 for STA-3/4, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 4.14 (which consists of screen information taken directly from the DMSTA output file).

Table 4.14 Results of DMSTA Analysis, STA-3/4 Alternative 1

Input Variable	Units	Value
Design Case Name	-	Alt 1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: STA-3/4 Alternative 1 **Filename:** 34FU_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.1%
Flow-Wtd Conc - With Bypass	ppb	13.9
Flow-Wtd Conc - Without Bypass	ppb	13.9
Geometric Mean Conc	ppb	10.1
95th Percentile Conc	ppb	19.2
Freq Cell Outflow > 10 ppb	%	44%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.48	0	0.28	0	0.24	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	12.298	14.115	10.287	11.712	8.713	9.822
Mean Width of Flow Path	km	3.42	4.50	2.89	4.02	4.88	4.88
Number of Tanks in Series	-	6	3	6	3	4	4
Outflow Control Depth	cm	60	60	60	60	60	60
Outflow Coefficient - Exponent	-	2.45	2.9	2.6	3	2.1	2.1
Outflow Coefficient - Intercept	-	0.68	0.77	0.85	1.05	0.52	0.52
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.0058	0.0029	0.0014	0	0.0038	0
Outflow Seepage Control Elev	cm	-56	-56	-67	0	-64	0
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.51	0.52	0.46	0	0.46	0
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	12.19	18.29	29.84	35.94	43.84	51.81	51.81
Run Date	-	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	12.298	14.115	10.287	11.712	8.713	9.822	66.9
Mean Water Load	cm/d	8.3	6.9	5.8	4.9	5.8	4.9	3.2
Max Water Load	cm/d	47.7	38.7	33.3	27.6	33.7	28.3	18.3
Inflow Volume	hm3/yr	372.4	353.8	217.3	211.5	186.2	176.3	775.9
Inflow Load	kg/yr	28148.0	17952.2	16419.7	9436.9	14074.0	8002.5	58641.8
Inflow Conc	ppb	75.6	50.7	75.6	44.6	75.6	45.4	75.6
Treated Outflow Volume	hm3/yr	353.8	342.3	211.5	209.2	176.3	174.4	726.0
Treated Outflow Load	kg/yr	17952.2	5429.4	9436.9	2587.4	8002.5	2088.7	10105.5
Treated FWM Outflow Conc	ppb	50.7	15.9	44.6	12.4	45.4	12.0	13.9
Total Outflow Volume	hm3/yr	353.8	342.3	211.5	209.2	176.3	174.4	726.0
Surface Outflow Load Reduc	%	36.2%	69.8%	42.5%	72.6%	43.1%	73.9%	82.8%
Outflow Geometric Mean - Daily	ppb	46.3	12.0	40.2	9.5	41.3	9.3	10.5
Outflow Geo Mean - Composites	ppb	45.9	11.7	39.7	9.0	40.8	8.9	10.1
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	100%	100%	57%

A condensed summary of the results of the analysis is presented in Table 4.15, which is considered reflective of the long-term treatment performance of STA-3/4 following full implementation of Alternative 1.

Table 4.15 Discharge Summary, STA-3/4 Alternative 1

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	726.0
Average Annual Outflow Volume	Ac-ft/yr	588,600
Average Annual Outflow TP Load	Kg/yr	10,178.2*
Flow-weighted Mean TP Concentration	ppb	14*
Geometric Mean TP Concentration, weekly composites	ppb	10

* Increased from computed value to reflect lower limit of calibration range.

Table 4.16 summarizes the estimated total discharges from STA-3/4, Alternative 1 over the 50-year period 2007-2056, given that:

- STA-3/4 will operate under Existing conditions over the period 2007-2014.
- STA-3/4 will operate under Alternative 1 conditions over the period 2015-2056.

Table 4.16 STA-3/4 Alt. 1, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	623,700	28,013.8	4,989,600	224,110
2015	2056	588,600	10,178.2	24,721,200	427,484
2007	**2056**	**594,216**	**13,031.9**	**29,710,800**	**651,594**
Flow-weighted mean TP Concentration in Discharges, ppb					**18**

4.4.4. Opinion of Probable Capital Cost

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 1:

- Construction of approximately 3.3 miles of interior levee, subdividing Cell 3 into Cells 3A and 3B.
- Construction of additional water control structures through the new levee subdividing Cell 3 into Cells 3A and 3B. These structures are assumed to be equivalent in number and character to Structures G-381 (six 8'x8' gated RCB's with telemetric control).
- Extension of an overhead power distribution line from the intersection of Interior Levee 3 and Interior Levee 4, extending north along Interior Levee 4 to the new levee across Cell 3, and then west along the new levee across Cell 3 (total length of approximately 3.6 miles).
- Small forward-pumping stations along the interior levees between cells in series to permit withdrawal from upstream emergent marsh cells to maintain stages in the downstream SAV cells. Three stations are anticipated. The station pumping from Cell 1A to Cell 1B is assigned a preliminary capacity of 54 cfs (equal to a maximum daily evaporation rate from Cell 1B of 0.24"/day, and an estimated seepage loss from Cell 1B of 0.13"/day). The stations pumping from Cell 2A to Cell 2B and from Cell 3A to Cell 3B are assigned preliminary capacities equal to 0.24"/day of evapotranspiration over the downstream cell (29 cfs in Cells 2, 24 cfs in Cells 3). Supplemental flows can be transferred from Cell 2A to Cell 1A through Structure G-382A, and between Cell 2A and Cell 3B through Structure G-382B.
- Herbicide treatment of Cells 1B, 2B and 3B for removal of emergent macrophyte vegetation to permit development of SAV.

An opinion of the probable capital cost for Alternative 1 is presented in Table 4.17.

Table 4.17 Opinion of Probable Capital Cost, STA-3/4 Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee, 7' height (Excludes Blasting Costs)	3.3	Mi.	$390,000	$1,287,000	Unit cost from Evaluation Methodology
2	Blasting for New Levee and Canals	3.3	Mi.	$48,000	$158,400	Allow Approx.$1/cy
3	New Water Control Structures (8'x8' similar to G-381, Gated)	6	Ea.	$190,000	$1,140,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
4	Water Control Structure Electrical (Includes Telemetry)	6	Ea.	$43,000	$258,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
5	Stilling Wells (Includes Electrical and Telemetry)	2	Ea.	$9,000	$18,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
6	Electrical Power Distribution	3.8	Mi.	$80,000	$304,000	Unit cost from Evaluation Methodology
7	Pumping Station, Cell 1A-1B	54	cfs	$9,900	$534,600	Unit cost from Evaluation Methodology
8	Pumping Station, Cell 2A-2B	29	cfs	$7,600	$220,400	Unit cost from Evaluation Methodology
9	Pumping Station, Cell 3A-3B	24	cfs	$7,600	$182,400	Unit cost from Evaluation Methodology
10	Eradication of Existing Vegetation	8809	ac	$200	$1,761,800	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$5,864,600**	**5,860,000**
Planning, Engineering & Design		10	%		$586,460	**590,000**
Program & Construction Management		10	%		$586,460	**590,000**
Total Estimated Cost, Without Contingency					**$7,037,520**	**7,040,000**
Contingency		30	%		$2,111,256	**2,110,000**
TOTAL ESTIMATED CAPITAL COST					**$9,148,776**	**9,150,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

4.4.5. Opinion of Probable Annual Costs for Operation & Maintenance

The following is a summary listing of the anticipated incremental operation and maintenance requirements for Alternative 1 (e.g., requirements in addition to those for operation of maintenance of STA-3/4 as presently designed):

- Maintenance of approximately 3.3 additional miles of interior levee.
- Operation and maintenance of the additional water control structures through the new levee subdividing Cell 3 into Cells 3A and 3B.
- Operation and maintenance of the three small forward-pumping stations along the interior levees between cells in series, included in the design to permit withdrawal from upstream emergent marsh cells to maintain stages in the downstream SAV cells. The pumps in these stations are assumed to be driven by electric motors. The unit operating costs are estimated using a power cost of $0.08/kw-hr; an assumed total head of 6 feet; an overall efficiency of 85%; and an assigned utilization equal to 10% of the overall time. The resultant power consumption is 0.43 kw/cfs, or 3,770 kw-hr/cfs/yr., yielding an approximate average annual cost of $300/yr/cfs.
- Additional herbicide treatment of Cells 1B, 2B and 3B for control of invasive species and emergent macrophyte vegetation. This item includes both:
    - Annual costs to spray for invasive species.
    - Additional costs for post-drought eradication of undesirable species.

The February 22, 2002 Draft *Supplemental Technology Standard of Comparison (STSOC) Analysis for Submerged Aquatic Macrophyte/Limerock Technology*, D.B Environmental, presents an estimated cost of $25/acre/year for regular herbicide treatment for control of invasive species, and an additional $10/acre/year for post-drought eradication spraying. Given the inclusion of the forward-pumping stations for maintenance of stages in the SAV cells, the opinion of probable incremental operation and maintenance cost includes a substantially reduced allowance of $10/acre/year for both those items.

An opinion of the probable incremental operation and maintenance cost for Alternative 1 is presented in Table 4.18.

Table 4.18 Opinion of Probable Incremental O&M Cost, STA-3/4 Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee	3.3	Mi.	$1,530	$5,049	Unit cost from Evaluation Methodology
2	New Water Control Structures	6	Ea.	$12,000	$72,000	Unit cost from Evaluation Methodology
3	Mech. Maintenance, Pumping Station, Cell 1A-1B, 2 units assumed	2	Ea.	$10,000	$20,000	Unit cost from Evaluation Methodology
4	Mech. Maintenance, Pumping Station, Cell 2A-2B, 1 unit assumed	1	Ea.	$10,000	$10,000	Unit cost from Evaluation Methodology
5	Mech.Maintenance, Pumping Station, Cell 3A-3B, I unit assumed	1	Ea.	$10,000	$10,000	Unit cost from Evaluation Methodology
6	Power Consumption, Pumping Station, Cell 1A-1B	54	cfs	$300	$16,200	See text for basis of estimated unit cost
7	Power Consumption, Pumping Station, Cell 2A-2B	29	cfs	$300	$8,700	See text for basis of estimated unit cost
8	Power Consumption, Pumping Station, Cell 3A-3B	24	cfs	$300	$7,200	See text for basis of estimated unit cost
9	Incremental Cost forAnnual Vegetation Control	8809	ac	$10	$88,090	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$237,239**	
Contingency		30	%		$71,172	
TOTAL INCREMENTAL O&M COST					**$308,411**	**$310,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

4.4.6. Total Present Worth

The total present cost of Alternative 1 is presented in Table 4.19, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation of 3%.

Table 4.19 Total Present Worth, STA-3/4 Alternative 1

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
Capital Costs						**Present Worth**
Year		**PED**	**P&CM**	**Const.**	**Total**	
2011		$769,816			$769,816	$441,399
2012			$396,455	$5,355,507	$5,751,962	$3,100,418
2013			$408,349	$5,516,172	$5,924,521	$3,002,050
Total Capital Cost					$12,446,299	$6,543,867
Incremental Costs for Operation and Maintenance						**Present Worth**
From	**To**			**Total O&M Cost**		
2015	2056				$37,340,687	$4,562,677
Total Present Worth of Alternative						**$11,106,543**

4.5. Alternative No. 2

Under Alternative No. 2, STA-3/4 would be modified to optimize its performance, with completion of all modifications and placement into service of the modified treatment area occurring prior to the end of 2006. For this analysis, that optimization is considered to consist of the conversion of Cells 1B and 2B from emergent vegetation to Submerged Aquatic Vegetation (SAV). In addition, the downstream 2,427 acres (53%) of Cell 3 would also be converted to SAV. Essentially, Alternative 2 would be identical to Alternative 1, with the exception of the proposed completion schedule.

4.5.1. Treatment Analysis Input Data Summary

As this alternative is considered as complete in 2006, inflows to the modified treatment area would be consistent with those projected for the Existing condition (e.g., estimated inflows prior to completion of the EAA Storage Reservoir, Phase 1 and 2 and other significant CERP projects) through 2014. After that date, inflows would be consistent with those for Alternative 1. Accordingly, inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 2 are taken from the "34EX_Data.xls" Excel file. Inflow volumes and TP loads are identical to those summarized in Table 4.1.

4.5.2. Summary of Input Variables for Treatment Analysis

Input variables employed in the analysis of Alternative 2 for STA-3/4 are identical to those established for the Alternative 1 analysis.

4.5.3. Results of DMSTA Analysis for Alternative 2

A detailed listing of input variables employed in the analysis of Alternative 2 for STA-3/4, together with a detailed listing of computed output variables resulting from that analysis, is presented in Table 4.20 (which consists of screen information taken directly from the DMSTA output file).

Table 4.20 Results of DMSTA Analysis, STA-3/4 Alternative 2

Input Variable	Units	Value	Case Description:	Filename:	34EX_Data.xls
Design Case Name	-	Alt 2	Convert STA-3/4 d/s cells to SAV by 2006		
Starting Date for Simulation	-	01/01/65			
Ending Date for Simulation	-	12/31/95			
Starting Date for Output	-	01/01/65			
Steps Per Day	-	3	**Output Variable**	**Units**	**Value**
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	0.0%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	14.3
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	14.3
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	9.8
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	19.5
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	35%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.48	0	0.28	0	0.24	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	12.298	14.115	10.287	11.712	8.713	9.822
Mean Width of Flow Path	km	3.42	4.50	2.89	4.02	4.88	4.88
Number of Tanks in Series	-	6	3	6	3	4	4
Outflow Control Depth	cm	60	60	60	60	60	60
Outflow Coefficient - Exponent	-	2.45	2.9	2.6	3	2.1	2.1
Outflow Coefficient - Intercept	-	0.68	0.77	0.85	1.05	0.52	0.52
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.0058	0.0029	0.0014	0	0.0038	0
Outflow Seepage Control Elev	cm	-56	-56	-67	0	-64	0
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.51	0.52	0.46	0	0.46	0
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	12.07	18.16	29.61	35.78	43.65	51.52	51.52
Run Date	-	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	12.298	14.115	10.287	11.712	8.713	9.822	66.9
Mean Water Load	cm/d	8.7	7.2	6.1	5.2	6.2	5.2	3.3
Max Water Load	cm/d	48.2	40.1	33.6	28.7	34.0	29.5	18.4
Inflow Volume	hm3/yr	391.6	373.1	228.4	222.7	195.8	186.0	815.9
Inflow Load	kg/yr	34595.0	21925.4	20180.4	11461.6	17297.5	9689.7	72073.0
Inflow Conc	ppb	88.3	58.8	88.3	51.5	88.3	52.1	88.3
Treated Outflow Volume	hm3/yr	373.1	361.6	222.7	220.5	186.0	184.1	766.2
Treated Outflow Load	kg/yr	21925.4	5940.0	11461.6	2793.7	9689.7	2246.4	10980.1
Treated FWM Outflow Conc	ppb	58.8	16.4	51.5	12.7	52.1	12.2	14.3
Total FWM Outflow Conc	ppb	58.8	16.4	51.5	12.7	52.1	12.2	14.3
Surface Outflow Load Reduc	%	36.6%	72.9%	43.2%	75.6%	44.0%	76.8%	84.8%
Outflow Geometric Mean - Daily	ppb	54.3	11.7	47.0	8.5	47.4	8.1	9.9
Outflow Geo Mean - Composites	ppb	54.4	11.7	47.0	8.4	47.6	8.0	9.8
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	100%	0%	50%

A condensed summary of the results of the analysis is presented in Table 4.21, which is considered reflective of the short-term treatment performance of STA-3/4 prior to the end of 2014. After 2014, the performance of Alternative 2 would be considered identical to that for Alternative 1.

Table 4.21 Discharge Summary, STA-3/4 Alternative 2#

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	766.2
Average Annual Outflow Volume	Ac-ft/yr	621,200
Average Annual Outflow TP Load	Kg/yr	10,980.1
Flow-weighted Mean TP Concentration	ppb	14
Geometric Mean TP Concentration, weekly composites	ppb	10

#see Table 4.15 for long-term results of STA-3/4 Alternative 2

Table 4.22 summarizes the estimated total discharges from STA-3/4, Alternative 2 over the 50-year period 2007-2056, given that:

- STA-3/4 will operate under Alternative 2 conditions over the period 2007-2014.
- STA-3/4 will operate under Alternative 1 conditions over the period 2015-2056.

Table 4.22 STA-3/4 Alt. 2, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	621,200	10,980.1	4,969,600	87,840.8
2015	2056	588,600	10,178.2	24,721,200	427,484
2007	**2056**	**593,816**	**10,306.5**	**29,690,800**	**515,325**
Flow-weighted mean TP Concentration in Discharges, ppb					**14**

4.5.4. Total Present Worth

Capital costs and incremental operation and maintenance costs for Alternative 2 are considered identical to those for Alternative 1, with the only variation consisting of the implementation schedule. The total present worth of Alternative 2 is presented in Table 4.23, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8% and an average annual cost escalation of 3%.

Table 4.23 Total Present Worth, STA-3/4 Alternative 2

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present**
Year		**PED**	**P&CM**	**Const.**	**Total**	**Worth**
2003		$607,700			$607,700	$571,281
2004			$312,966	$4,227,687	$4,540,652	$4,012,722
2005			$322,354	$4,354,517	$4,676,872	$3,885,409
Total Capital Cost					$9,825,224	$8,469,412
Incremental Costs for Operation and Maintenance						**Present**
From	**To**			**Total O&M Cost**		**Worth**
2007	2056				$40,536,370	$6,393,362
Total Present Worth of Alternative						**$14,862,774**

4.6. Summary of Evaluation Criteria Scoring

The following tables present summaries of the evaluation criteria scoring for the alternative water quality improvement strategies for STA-3/4. The information presented therein will subsequently be employed by the District and others in further evaluation of the alternatives, and identification of that alternative or alternative(s) to be carried forward to the conceptual design phase.

Table 4.24 Summary Evaluation Criteria Scores, STA-3/4 Alternative 1

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	1,198	Table 4.13
		50-Year TP Load Disc. - Alternative 1	tonnes	652	Table 4.16
		Phosphorus Load Reduction	%	45.6	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	14*	Table 4.15
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10	Table 4.15
3	Implementation Schedule		years	12	2014 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$11,106,543	Table 4.19
	2	Total 50-Year TP Removal	kg	546,630	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$20.32	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

* Computed F.W.M. Conc. Less than LSC assigned as 14 ppb.

Table 4.25 Summary Evaluation Criteria Scores, STA-3/4 Alternative 2

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	1,198	Table 4.13
		50-Year TP Load Disc. - Alternative 2	tonnes	515	Table 4.22
		Phosphorus Load Reduction	%	57.0	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	14*	Table 4.15
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10	Table 4.15
3	Implementation Schedule		years	4	STSOC (See Part 1)
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$14,862,774	Table 4.23
	2	Total 50-Year TP Removal	kg	682,899	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$21.76	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)

- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

* Computed F.W.M. Conc. Less than LSC assigned as 14 ppb.

4.7. Sensitivity Analyses of Phosphorus Reduction Parameters

The effectiveness of phosphorus reduction in the alternatives considered are examined with respect to the change in the following three input parameters presented in the sensitivity analyses:

- Varying BMP Performance
- Different SAV Communities
- All Input Parameters
  - Uncertainty Analysis

The third analysis (all input parameters) also employs an uncertainty analysis. The information presented therein will assist the District in further analyses of the alternatives presented in the future evaluation of the parameters.

4.7.1. Variation in BMP Performance

The current level of 50% TP load reduction in basin runoff due to BMPs in the EAA was varied to 25% and 75% TP load reduction to determine the effects the performance level of BMP on the phosphorus reduction parameters. The TP inflows into STA-3/4 were recalculated, including those involving the EAA Storage Reservoir Phase 1 and 2 projects. Table 4.26 summarizes, for all four alternatives, the outcome of the phosphorus reduction performance due to varying BMP performance.

The results show that the phosphorus reduction performance is less sensitive to BMP performance with either Alternative 1 or 2 than in the baseline conditions.

Table 4.26 Variation in BMP Performance

Condition	Location	TP Conc. For BMP Load Reduction in S-7 & S-8 Basins of					
		25%		50%		75%	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
Baseline, Existing	STA-3/4 Inflows	118	--	88	--	59	--
	STA-3/4 Outflows	46	46	36	36	26	26
Baseline, Future	STA-3/4 Inflows	91	--	76	--	60	--
	STA-3/4 Outflows	37	35	32	30	27	25
Alternative 1 (Post-CERP)	STA-3/4 Inflows	91	--	76	--	60	--
	STA-3/4 Outflows	15	11	14*	10	14*	10**
Alternative 2 (Pre-CERP)	STA-3/4 Inflows	118	--	88	--	59	--
	STA-3/4 Outflows	17	12	14	10	14*	10**

*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

4.7.2. Variation in SAV Performance

The current vegetative community (SAV_C4) was changed to the vegetative community (NEWS) to determine the effects of different vegetative communities on the phosphorus reduction parameters. Table 4.27 summarizes, for Alternatives #1 and #2, the outcome of the phosphorus reduction performance due to different SAV communities.

Table 4.27 Variation in SAV Performance

Condition	Location	TP Conc. For Different SAV Communities			
		SAV_C4		NEWS	
		F.W.	Geo.	F.W.	Geo.
Alternative 1 (Post-CERP)	STA-3/4 Inflows	76	--	76	--
	STA-3/4 Outflows	14*	10	21	15
Alternative 2 (Pre-CERP)	STA-3/4 Inflows	88	--	88	--
	STA-3/4 Outflows	14	10	21	14

*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.

The results show that the phosphorus reduction performance is fairly sensitive to the SAV community used.

4.7.3. All Input Variables (DMSTA Sensitivity Model)

The sensitivity of the phosphorus reduction performance to all input variables available in the DMSTA model was tested through its built-in Sensitivity Model which also includes an Uncertainty Analysis module. The Sensitivity Model assesses the average percent change in these four output parameters for each input changed:

- Treated Flow-weighted Mean Outflow Concentration
- Total Flow-weighted Mean Outflow Concentration
- Outflow Geometric Mean – Composite
- Total Outflow Load

A Sensitivity Scale Factor of 25% (i.e. 25% change in each input) was used in all runs. Both high and low results were tested; in other words, two runs were conducted for each input variable, one at 75% and the other at 125% of the original value of the input variable under consideration. With approximately 25 different input variables, multiplied by the number of cells in the STA, and the high and low end of results tested, the Sensitivity Analysis included a potential of 140 or more DMSTA runs for each case.

No change in output from each run for each case exceeded 25%. The biggest changes in the four output variables, consistently across each case, were caused by the following input variables:

- Inflow Fraction
- Surface Area
- "K" Settling Rate

The DMSTA Model also includes an Uncertainty Analysis which lists the actual change of any one of the four above-listed output variables based on the "uncertainty" of the input variables. If one of the 23 variables (available in this analysis) under consideration is insensitive, then the range of values will not change significantly.

The DMSTA Uncertainty Analysis uses results from the above Sensitivity Model. The input into the model is the variable labeled "Error CV", which is the Standard Error divided by the Mean. The default input Error CV in the DMSTA model was utilized for the analyses. The outputs are the 10th, 50th, and 90th percentile estimate of the four listed output parameters.

Since the analysis of STA-3/4 includes no bypass analysis, the resultant Total Flow-weighted Mean Outflow Concentration is the same as the resultant Treated Flow-weighted Mean Outflow Concentration. Outputs from the four DMSTA cases are shown in Table 4.28:

Table 4.28 Uncertainty Analyses of All Input Variables

Condition	Location	TP Conc. In DMSTA Sensitivity Analyses								
		10th Percentile Est.			50th Percentile Est.			90th Percentile Est.		
		F.W.	Geo.	Load	F.W.	Geo.	Load	F.W.	Geo.	Load
Baseline, Existing	STA-3/4 Outflows	28	27	21,618	36	36	28,014	45	44	34,409
Baseline, Future	STA-3/4 Outflows	25	23	17,898	32	30	23,193	39	38	28,485
Alternative 1 (Post-CERP)	STA-3/4 Outflows	14*	10**	10,178*	14*	10	10,178*	17	12	12,420
Alternative 2 (Pre-CERP)	STA-3/4 Outflows	14*	10**	10,178*	14	10	10,980	18	12	13,503

* Increased from computed value to reflect lower limit of calibration range.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

The results show that there is a fairly wide range of uncertainty in phosphorus reduction performance, particularly in the baseline conditions.

Table of Contents

List of Tables

List of Figures

5. STORMWATER TREATMENT AREA NO. 5 & 6 (STA-5 ,6)

STA-5 and 6 are two separate stormwater treatment areas which share several inflow sources, and thus are highly interrelated. STA-5 and STA-6 (Section 1) are currently operating; Section 2 is presently scheduled for completion in 2006. Both Section 1 and Section 2 of STA-6 are considered as now complete for the purpose of this analysis.

STA-5 provides a total effective treatment area of 4,110 acres, situated generally on lands between L-2 Borrow Canal (on the west) and Rotenberger Wildlife Management Area (on the east), immediately northeast of the confluence of the Deer Fence Canal with the L-2 Borrow Canal. This stormwater treatment area is intended to treat inflows from the L-2 Borrow Canal (via Structure G-342). These inflows are comprised of contributions from the following:

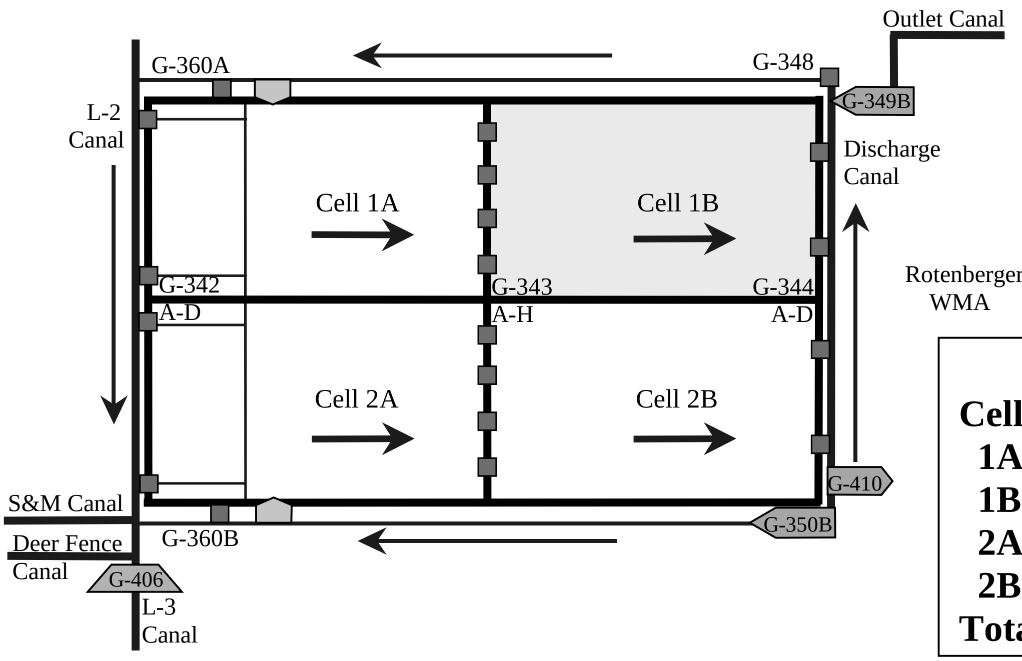
- Agricultural runoff and discharges from the C-139 Basin (partial, see discussion for STA-6)
- Supplemental (irrigation) water necessary to prevent dryout of the STA from Lake Okeechobee

STA-6 Section 1 currently provides a total effective treatment area of 870 acres, situated on lands between L-3 Borrow Canal (on the west) and Rotenberger Wildlife Management Area (on the east), immediately north of the confluence of the L-3 and L-4 Borrow Canals. Section 2 will provide an additional total effective treatment area of approximately 1400 acres, immediately north of Section 1. Inflows to STA-6 are comprised of contributions from a number of sources, including:

- Agricultural runoff and discharge from the United States Sugar Corporation's (USSC) Southern Division Ranch, Unit 2.
- Agricultural runoff and discharges from the USSC Southern Division Ranch, Unit 1 (the "C-139 Annex")
- Agricultural runoff and discharges from the C-139 Basin (HIGH Flows diverted from STA-5)
- Supplemental (irrigation) and BMP water necessary to prevent dryout of the STA from Lake Okeechobee

STA-5 has two parallel flow paths, each developed with cells in series, each with an easterly flow direction. Both STA 5 and STA 6 have emergent macrophytic vegetative communities in all cells except for STA 5 Cell 2B, which is presently being developed as an SAV community.

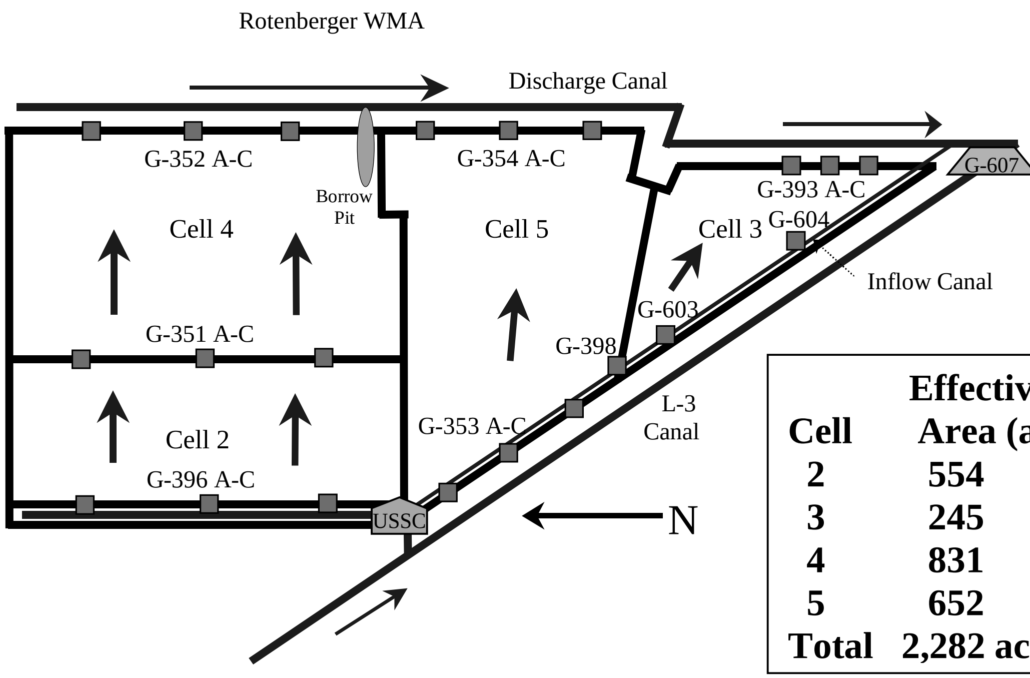
Current schematic designs of STA-5 and STA-6 are presented in Figures 5.1 and 5.2.



Cell	Effective Area (ac)
1A	835
1B	1,220
2A	835
2B	1,220
Total	4,110 ac

Figure 5.1. Schematic of STA-5

It should here be noted that the schematic design of STA-6 as presented in Figure 5.2 does vary in certain respects from the current (90%) design of STA-6, Section 2. Section 2 has been rearranged such that Cells 2 and 4 are in series, not in parallel.



Cell	Effective Area (ac)
2	554
3	245
4	831
5	652
Total	2,282 ac

Figure 5.2. Schematic of STA-6

5.1 Existing Conditions

An analysis of Existing Conditions was prepared to assess the probable performance of STA-5, 6 under regional conditions existing upon completion of the Everglades Construction Project, but prior to completion of other major initiatives (such as the Comprehensive Everglades Restoration Plan, or CERP). That analysis was prepared for a thirty-one year period, extending from 1965 through 1995, using simulated inflow volumes from the District's South Florida Water Management Model (SFWMM) and inflow total phosphorus (TP) loads developed as defined in the District's May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies.* The probable performance of STA-5, 6 in reducing total phosphorus was evaluated through use of the DMSTA software, version dated April 12, 2002 (additional information on this software is presented in Part 1).

5.1.1 Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Existing Conditions for STA-5, 6. Daily inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Existing Conditions are included in Excel files “5EX_Data.xls” and “6EX_Data.xls”..

Inflow Volumes and TP Loads: As presented in the District’s May, 2001 *Baseline Data for the Basin-Specific Feasibility Studies*, the estimated average annual inflows to STA-5 over the 31-year period are 132,113 acre-feet per year at a flow-weighted mean inflow concentration of 178 ppb (29.01 metric tons inflow TP per year) and to STA-6 over the 31-year period are 37,887 acre-feet per year at a flow-weighted mean inflow concentration of 85 ppb (39.72 metric tons inflow TP per year).

Daily estimates of inflow by source were taken from an Excel spreadsheet prepared by the District in connection with preparation of the *Baseline Data* (file names “sta5 inflow tp_baserr2r.xls” dated January 28, 2002 and “sta6_inflow tp_baserr2r.xls--revised” dated May 28, 2002). Tables 5.1 and 5.2 summarize the estimated average annual inflow volumes and total phosphorus (TP) loads and concentrations to STA-5, 6 represented in those daily estimates. However, it should be recognized that there is a large degree of uncertainty of applicability associated with these inflows generated by SFWMM into STA-5. Any alternative for which the LSC is barely met should be critically examined before accepting as the solution meeting the long-term goal of reaching LSC.

Table 5.1. Estimated Inflows, STA-5 Existing Analysis, 1965-1995

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
C-139 Basin	132,036	29.03	178
Lake Okeechobee Water Supply	77	0.01	67
Total Average Annual Inflows	**132,113**	**29.04**	**178**

Table 5.2. Estimated Inflows, STA-6 Existing Analysis, 1965-1995

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
USSC Inflow	33,746	3.10	74
C-139 Basin	3,065	0.85	224
Lake Okeechobee Water Supply	1,076	0.09	66
Total Average Annual Inflows	**37,887**	**4.04**	**86**

Rainfall: For the 31-year period, daily estimates of rainfall over the surface of STA-5, 6 were taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name “2050wPROJ_rfet.xls” dated March 11, 2002; worksheet identification “RF-STAs(inches)”). The average annual rainfalls over the surface of STA-5, 6 as reflected in that data file are estimated to be 47.98” and 52.01”.

Evapotranspiration: Daily estimates of evapotranspiration over the surface of STA-5, 6 were also taken from the SFWMM simulation; the daily values were taken from a District-furnished Excel workbook (file name “2050wPROJ_rfet.xls” dated March 11, 2002; worksheet identification “ET-STAs(inches)”). The average annual evapotranspiration over the surface of STA-5 ,6 as reflected in that data file are estimated to be 54.80” and 53.78”. It should here be noted that the daily ET values were estimated as specific to the operation of STA-6 under the 2050 “with-CERP” simulation, and may not be fully representative of ET for the baseline condition. However, the analysis is not sensitive to minor variations in ET, and further refinement of those daily estimates is considered unnecessary for feasibility-level analyses.

5.1.2 Summary of Input Variables

The following paragraphs summarize input variables employed in the analysis of Existing Conditions for STA-5, 6. Those input variables are defined in an Excel worksheet entitled “Baseline” included in workbooks “5EX_Data.xls” and “6EX_Data.xls.

Hydraulic Properties: Depth-discharge relationships specified in the DMSTA input file for each cell of STA-5, 6 were based on analysis of detailed information presented in the September 1997 *Final Design Report* for STA 5 and March 1997 *Detailed Design Report* for STA 6. The DMSTA parameters for emergent macrophytic vegetative communities were adjusted to closely approximate the relationships developed from that source. A summary of that analysis is presented in Tables 5.3 and 5.4. The outlet control depth in each cell (except Cell 1B) was established at 40 cm (approx. 15"), consistent with the current design basis for both STAs. STA-5 Cell 1B outlet control depth is 60 cm (approx. 24").

Table 5.3 STA-5 Hydraulic Properties, Existing Design

Cell	Mean Ground Elev.(ft. NGVD)	Discharge (cfs)	Discharge (hm*3/d)	Ave. Cell Width (km)	Mean Stage (ft. NGVD)	Mean Depth (ft)	Depth (m)	Coeff. A (m)	Exp. B	Computed Discharge (hm*3/d)	Ratio, Comp. Q/Target
1A	12.25	628	1.536	1.56	15.05	2.80	0.853	1.57	2.8	1.573	1.02
	12.25	882	2.158	1.56	15.35	3.10	0.945	1.57	2.8	2.092	0.97
	12.25	1,276	3.122	1.56	15.85	3.60	1.097	1.57	2.8	3.179	1.02
1B	11.50	628	1.536	1.56	13.85	2.35	0.716	2.02	2.15	1.535	1.00
	11.50	882	2.158	1.56	14.25	2.75	0.838	2.02	2.15	2.153	1.00
	11.50	1,276	3.122	1.56	14.77	3.27	0.997	2.02	2.15	3.124	1.00
2A	12.25	628	1.536	1.56	15.10	2.85	0.869	1.51	2.91	1.565	1.02
	12.25	882	2.158	1.56	15.40	3.15	0.960	1.51	2.91	2.094	0.97
	12.25	1,276	3.122	1.56	15.88	3.63	1.106	1.51	2.91	3.165	1.01
2B	11.50	628	1.536	1.56	13.65	2.15	0.655	2.10	1.78	1.541	1.00
	11.50	882	2.158	1.56	14.08	2.58	0.786	2.10	1.78	2.132	0.99
	11.50	1,276	3.122	1.56	14.70	3.20	0.975	2.10	1.78	3.129	1.00

Table 5.4 STA-6 Hydraulic Properties, Existing Design

Cell	Mean Ground Elev.(ft. NGVD)	Discharge (cfs)	Discharge (hm*3/d)	Ave. Cell Width (km)	Mean Stage (ft. NGVD)	Mean Depth (ft)	Depth (m)	Coeff. A (m)	Exp. B	Computed Discharge (hm*3/d)	Ratio, Comp. Q/Target
2	12.25	97	0.237	2.34	14.52	2.27	0.692	0.18	1.67	0.227	0.96
	12.25	188	0.460	2.34	15.70	3.45	1.052	0.18	1.67	0.457	0.99
	12.25	255	0.624	2.34	16.75	4.50	1.372	0.18	1.67	0.712	1.14
3	12.37	28	0.069	0.61	14.21	1.84	0.561	0.63	3.08	0.065	0.95
	12.37	140	0.343	0.61	16.03	3.66	1.116	0.63	3.08	0.542	1.58
	12.37	440	1.077	0.61	16.40	4.03	1.228	0.63	3.08	0.729	0.68
4	12.25	97	0.237	2.32	14.45	2.20	0.671	0.20	1.67	0.238	1.00
	12.25	188	0.460	2.32	15.43	3.18	0.969	0.20	1.67	0.441	0.96
	12.25	255	0.624	2.32	16.25	4.00	1.219	0.20	1.67	0.647	1.04
5	12.38	184	0.450	1.31	15.89	3.51	1.070	0.26	4.16	0.452	1.00
	12.38	245	0.599	1.31	16.14	3.76	1.146	0.26	4.16	0.601	1.00

Seepage: Generalized estimates of seepage losses used in this analysis from STA-5, 6 were taken from information presented in Appendix C of *STA-5 Final Design Report*, Burns & McDonnell (based on Design Values for K=148 ft/Day) and Appendix D of *STA-6 Detailed Design Report*, Burns & McDonnell (based on Design Values for K=150 ft/Day). However, seven months of collected data in STA-5 show that the volumes and loads in seepage return are greater than that modeled in the SFWMM. STA-5 would benefit from adding an extra seepage return pump station in both the north and south seepage collection canals, located to deliver water to the downstream cells (i.e. Cell 1B and 2B), although there is no current basis for computing modified performance.

A summary of the seepage losses and estimated recoveries from the various cells of STA-5,6, based on the information presented in both documents, is presented in Tables 5.5 and 5.6.

Table 5.5 Estimated Seepage Loss Rates and Recovery from STA-5

Cell	Location	Length (ft)	Rate (cf/d/ft/ft))	Total Seepage (cf/day/ft)	Cell Area (ac)	Loss Rate (ft/d/ft)	Loss Rate (m/yr/m)	% Recovery
1A	North Line	7,100	7.6	53,960	835	0.00148	0.541	50
1B	North Line	10,400	7.0	72,800	1,220	0.00137	0.500	50
2A	South Line	7,100	7.6	53,960	835	0.00148	0.541	50
2B	South Line	10,400	16.9	175,760	1,220	0.00331	1.207	50
Cell	**Location**	**Ave. Grade (ft. NGVD) ***	**Control Elev. (ft. NGVD)**	**Relative to Ave. Grade (ft)**	**Relative to Ave. Grade (cm)**	**Remarks**		
1A	North Line	12.25	10.75	-1.5	-46	App C - Table 3 Design Value		
1B	North Line	11.50	10.25	-1.25	-38	App C - Table 3 Design Value		
2A	South Line	12.25	10.75	-1.5	-46	App C - Table 3 Design Value		
2B	South Line	11.50	10.25	-1.25	-38	App C - Table 3 Design Value		

Table 5.6 Estimated Seepage Loss Rates and Recovery from STA-6

Cell	Location	Length (ft)	Rate (cf/d/ft/ft))	Total Seepage (cf/day/ft)	Cell Area (ac)	Loss Rate (ft/d/ft)	Loss Rate (m/yr/m)	% Recovery
2	North Line	3,150	13.1	41,265	554	0.00171	0.624	50
2	West Line	7,700	13.0	100,100	554	0.00415	1.514	50
	Total	(Similar control elevation both locations)				0.00586	2.138	50
4	North Line	4,750	13.1	62,225	831	0.00172	0.627	50
Cell	**Location**	**Ave. Grade (ft. NGVD)**	**Control Elev. (ft. NGVD)**	**Relative to Ave. Grade (ft)**	**Relative to Ave. Grade (cm)**	**Remarks**		
2	North Line	12.25	10.75	-1.5	-46	App D - Table 3 Design Value		
2	West Line	12.25	10.75	-1.5	-46	App D - Table 3 Design Value		
4	North Line	12.25	10.75	-1.5	-46	App D - Table 3 Design Value		

Treatment Parameters: As presently designed, STA-5, 6 are intended to consist entirely of emergent macrohpytic marsh, except for STA-5 Cell 1B which presently has SAV. Default values in the DMSTA model for Emergent communities (except STA-5 Cell 1B for which default values for SAV_C4 were used)) were employed in the analysis of existing conditions.

No. of CSTRs in Series: The design of STA-5, 6 is developed to maximize the extent to which uniform flow distribution can be developed in each cell. For analysis of existing conditions, a total of three Continuous Stirred Tank Reactors (CSTRs) in series was assigned in each cell, other than as follows. The presence of transverse deep zones can be expected to improve overall flow patterns through flow redistribution. However, no significant transverse canals exist in STA 5, 6, thus a total of 3 CSTRs in series remains unchanged.

5.1.3 Results of DMSTA Analysis for Existing Conditions (Baseline 2007-2014)

Detailed listings of input variables employed in the analysis of Existing Conditions for STA-5, 6, together with detailed listings of computed output variables resulting from those analyses, are presented in Tables 5.7 and 5.8 (which consist of screen information taken directly from the DMSTA output file).

Table 5.7 Results of DMSTA Analysis, STA-5 Existing Design (Baseline 2007-2014)

Input Variable	Units	Value
Design Case Name	-	Baseline
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Existing, 100% Emergent except Cell 1B--SAV_C4 **Filename:** 5EX_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	44.6
Flow-Wtd Conc - Without Bypass	ppb	44.6
Geometric Mean Conc	ppb	31.9
95th Percentile Conc	ppb	53.4
Freq Cell Outflow > 10 ppb	%	100%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B		
Vegetation Type	------->	EMERG	SAV_C4	EMERG	EMERG		
Inflow Fraction	-	0.5	0	0.5	0		
Downstream Cell Number	-	2	0	4	0		
Surface Area	km2	3.379	4.937	3.379	4.937		
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	60	40	40		
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78		
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0033		
Outflow Seepage Control Elev	cm	-46	-38	-46	-38		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*15.66*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.00	11.94	17.45	22.97			22.97
Run Date	-	05/28/02	05/28/02	05/28/02	05/28/02			05/28/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1A	1B	2A	2B			Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow			-
Surface Area	km2	3.379	4.937	3.379	4.937			16.6
Mean Water Load	cm/d	6.6	4.4	6.6	4.4			2.7
Max Water Load	cm/d	60.0	40.5	60.0	40.4			24.4
Inflow Volume	hm3/yr	81.5	80.2	81.5	80.2			163.1
Inflow Load	kg/yr	14531.8	9296.2	14531.8	9241.2			29063.6
Inflow Conc	ppb	178.2	115.9	178.2	115.3			178.2
Treated Outflow Volume	hm3/yr	80.2	78.2	80.2	77.1			155.3
Treated Outflow Load	kg/yr	9296.2	1528.1	9241.2	5402.3			6930.5
Treated FWM Outflow Conc	ppb	115.9	19.5	115.3	70.0			44.6
Total FWM Outflow Conc	ppb	115.9	19.5	115.3	70.0			44.6
Surface Outflow Load Reduc	%	36.0%	83.6%	36.4%	41.5%			76.2%
Outflow Geometric Mean - Daily	ppb	117.8	11.2	117.7	62.3			33.3
Outflow Geo Mean - Composites	ppb	117.5	10.4	117.4	61.2			31.9
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%			96%

Table 5.8 Results of DMSTA Analysis, STA-6 Existing Design (Baseline 2007-2014)

Input Variable	Units	Value	Case Description:		Filename:	6EX_Data.xls
Design Case Name	-	Baseline	Existing, 100% Emergent			
Starting Date for Simulation	-	01/01/65				
Ending Date for Simulation	-	12/31/95				
Starting Date for Output	-	01/01/65				
Steps Per Day	-	3	**Output Variable**		**Units**	**Value**
Number of Iterations	-	2	Water Balance Error		%	0.0%
Output Averaging Interval	days	7	Mass Balance Error		%	0.1%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass		ppb	28.3
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass		ppb	28.3
Max Reservoir Storage	hm3	0	Geometric Mean Conc		ppb	20.3
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc		ppb	29.0
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb		%	100%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load		%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	2	4	3	5		
Vegetation Type	------->	EMERG	EMERG	EMERG	EMERG		
Inflow Fraction	-	0.6	0	0.11	0.29		
Downstream Cell Number	-	2	0	0	0		
Surface Area	km2	2.242	3.363	0.991	2.639		
Mean Width of Flow Path	km	2.34	2.32	0.61	1.31		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	40	40	40		
Outflow Coefficient - Exponent	-	1.67	1.67	3.08	4.16		
Outflow Coefficient - Intercept	-	0.18	0.2	0.63	0.26		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0059	0.0017	0	0		
Outflow Seepage Control Elev	cm	-46	-46	0	0		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0	0		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*15.66*	*15.66*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.94	14.07	21.58	27.87			27.87
Run Date	-	06/11/02	06/11/02	06/11/02	06/11/02			06/11/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		2	4	3	5			Total Outflow
Downstream Cell Label		4	Outflow	Outflow	Outflow			-
Surface Area	km2	2.242	3.363	0.991	2.639			9.2
Mean Water Load	cm/d	3.4	2.1	1.4	1.4			1.4
Max Water Load	cm/d	86.3	58.9	35.8	35.4			34.9
Inflow Volume	hm3/yr	28.1	25.9	5.1	13.6			46.8
Inflow Load	kg/yr	2427.3	1274.9	445.0	1173.2			4045.4
Inflow Conc	ppb	86.5	49.3	86.5	86.5			86.5
Treated Outflow Volume	hm3/yr	25.9	24.9	5.1	13.4			43.5
Treated Outflow Load	kg/yr	1274.9	676.8	174.9	378.6			1230.3
Treated FWM Outflow Conc	ppb	49.3	27.2	34.3	28.2			28.3
Total FWM Outflow Conc	ppb	49.3	27.2	34.3	28.2			28.3
Surface Outflow Load Reduc	%	47.5%	46.9%	60.7%	67.7%			69.6%
Outflow Geometric Mean - Daily	ppb	39.5	19.9	25.3	19.4			22.1
Outflow Geo Mean - Composites	ppb	40.1	19.9	25.5	19.7			20.3
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%			100%

Condensed summaries of the results of the analyses are presented in Tables 5.9 and 5.10.

Table 5.9 Discharge Summary, STA-5 Existing Conditions (Baseline 2007-2014)

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	155.3
Average Annual Outflow Volume	Ac-ft/yr	125,900
Average Annual Outflow TP Load	Kg/yr	6,930.5
Flow-weighted Mean TP Concentration	ppb	45
Geometric Mean TP Concentration, weekly composites	ppb	32

Table 5.10 Discharge Summary, STA-6 Existing Conditions (Baseline 2007-2014)

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	43.5
Average Annual Outflow Volume	Ac-ft/yr	35,300
Average Annual Outflow TP Load	Kg/yr	1,230.3
Flow-weighted Mean TP Concentration	ppb	28
Geometric Mean TP Concentration, weekly composites	ppb	20

5.2 Baseline 2015-2056 Conditions for STA-5 & 6

Basins tributary to STA-6 are scheduled to receive certain component projects of the Comprehensive Everglades Restoration Program (CERP). The most significant of these is the component entitled “EAA Storage Reservoir”. As a result, Baseline 2015-2056 conditions should properly be considered as those which will result from implementation of the EAA Storage Reservoir project, and other elements of CERP which may substantially influence inflows to both STA-6 and the EAA Storage Reservoir. In the 2050wPROJ simulation, STA-5 did not receive flows from EAA Storage Reservoir, but STA-5 received an increase in flows in the 2050wPROJ simulation to meet environmental targets in the Rotenberger Wildlife Management Area. For this analysis, Existing conditions (Baseline 2007-2014) are assigned to the 8-year period 2007-2014, and Baseline 2015-2056 conditions to the 42-year period 2015-2056.

The October 30, 2001 draft of *Preliminary Alternative Combinations for the ECP Basins* postulates that, after the EAA Storage Reservoir Project Phase 1 and 2 becomes operational, there will be peak flow attenuation and considerable flow increase into STA-6, and some possible increase in inflow TP loads to STA-6. The anticipated net effect of those modifications to inflow volumes and loads was projected to be a negligible decrease in water quality performance in STA-6.

5.2.1 Influence of EAA Storage Reservoir Phase 1 and 2 Project

The EAA Storage Reservoirs concept referenced in this report is based on a South Florida Water Management Model simulation (2050wPROJ) which was performed specifically for the evaluation of alternatives during the conduct of the Basin-Specific Feasibility Studies. This simulation, which influences both Phase 1 and Phase 2 of the EAA Storage Reservoirs project, includes assumptions which may or may not be consistent with the CERP project goals and assumptions. The Project Delivery Team will perform regional modeling in support of the PIR development and selection of the recommended plan for the EAA Storage Reservoir Phase 1 project. Close coordination between the EAA Storage Reservoir Project and the Basin-Specific Feasibility Studies Project is necessary to ensure the goals of both projects are met.

The EAA Storage Reservoir project as formulated in that simulation includes a total of four compartments, of which only the operation of one of which will impact inflow volumes and TP loads to STA-6, and possibly STA-5. This compartment (C) was simulated to be situated north of STA-6, south of STA-5, generally between the L-3 Canal and Rotenberger WMA. The balance of this analysis of the influence of the EAA Storage Reservoir Phase 1 and 2 project on inflow volumes and TP loads to STA-6 is based on the project formulation and operation reflected in the District's South Florida Water Management Model (2050wPROJ) run for conditions in 2050 following full implementation of CERP.

Compartment C was simulated to receive regulatory releases from Lake Okeechobee, intended for use in satisfying environmental water supply demands. Outflows from Compartment C was simulated to be directed to STA-6, and to consist of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface).

A schematic of the fluxes to and from Compartment C of the EAA Storage Reservoir project is presented in Figure 5.3. The area of Compartment C, initially created by the 2-mile by 2-mile grid system in the SFWMM is 12,800 acres was used in this study; a memo (Pro ECP 15, by SFWMD HSM WSD dated April 15, 2002) stated Compartment C as 9,000 acres. This area difference has no effect for STA-5 for the baseline or Alternatives 1-3 because no flows are routed through Compartment C. For STA-6, the reservoir outflow concentration is reduced from 71 ppb to 65 ppb due to a large decrease in surface area (i.e. reduced atmospheric deposition); the effect of the difference on STA-6 Alternatives' outflow is on the order of less than 1 ppb. Using the 12,800 acres, while producing a conservative estimate does not change any of the decision outcomes of the STAs (i.e. requirement of studying further alternatives to bring the STAs outflow concentrations down to LSC).

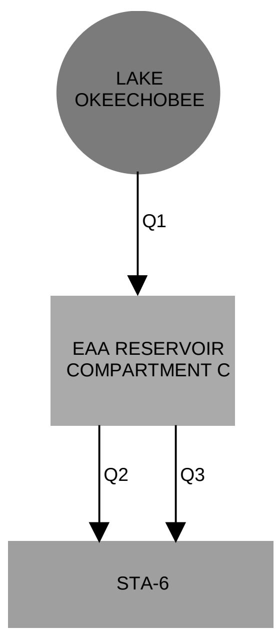


Figure 5.3 EAA Storage Reservoir Phase 1 and 2 Flow Schematic Vicinity STA-6

A summary of the average annual transfer volumes and TP loads between the various reservoir compartments and STA-6 is presented in Table 5.11.

Table 5.11 Average Annual Inflows and Outflows, EAA Storage Reservoir Phase 1 and 2 Vicinity STA-6

Flow Ident.	Description	Ave. Annual Inflow		
		Volume (acre-feet)	TP Load (kg)	TP Conc. (ppb)
Q1	Lake Regulatory Release to C	50,033	4,111	67
Q2	STA-6 Inflow from C, Surface	42,243	3,491	67
Q3	STA-6 Inflow from C, Subsurface	3,086	76	20
	Total Compartment C Outflows	45,329	3,567	64
	Total STA-6 Inflows from EAA Reservoirs	45,329	3,567	64

The following paragraphs define the source of data summarized in Table 5.11.

Hydrologic Data: Daily reservoir inflow and outflow volumes for the 31-year period of simulation 1965-1995 are taken from the following Excel files furnished by the District:

- Cin.xls, dated March 5, 2002.
- Cout.xls, dated March 4, 2002.

Those files also include estimated daily inflow TP loads by source, other than for discharges from the compartments (subsequently discussed herein). Daily rainfall and evapotranspiration in Compartments C were assigned at the values employed for the existing conditions analysis of STA-6. Daily stages in each compartment of the reservoir were taken from another District-furnished Excel file ("EAAres_daily_stages.xls", dated February 15, 2002).

TP Loads: As noted above, daily estimates of TP inflow loads to the various reservoir compartments (other than overflows from one compartment to another) were taken from the District-furnished Excel files. For this analysis, it was necessary to estimate TP concentrations in the reservoir in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir. Those estimates were developed on the assumption that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoirs was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates in each compartment were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. A Summary of the long-term estimate of TP reduction in the Compartment C is presented in Table 5.12.

The estimated performance the EAA Storage Reservoir compartments in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 5.12 Estimated Long-Term Average Outflow Concentration, Compartment C

Mean Depth in Reservoir (m)	(For wet period fraction)				**0.768**
Approx. Basin Area (acres)					**12,800**
Approx. Basin Area (sq.m.)					**51,799,936**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)				
Input Parameters			**Estimated TP Removal**		
Average Inlet Concentration	mg/l	0.0666	q	1.088	
Average Annual Inflow Volume	ac/ft	50,033	K	0.009	
Average Annual Inflow Volume	cu.m.	61,715,000	P	104	ppb
Average Annual Rainfall	m	1.321	N	0.695	
Average Annual Evapotranspiration	m	1.366		1.944	
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.026	R	0.321	
Infiltration from Groundwater	m/yr	0.000	Pout	71	ppb
Water Balance Adjustment & Exfiltration	m/yr	0.083	Pout	0.0710	mg/l
Change in Storage	m./yr.	0.058	REF:	*Phosphorus Removal by Urban Runoff Detention Basins;* Lake and Reservoir Management, Volume 3; North American Lake Management Society; 1987	
Ave. TP Conc. In Seepage Inflows	mg/l	0.000			
Wet Period Fraction		0.733			
SUMMARY OF RESULTS					
Reservoir Area	acres	12,800			
Ave. Annual Outflow Volume	cu.m.	52,106,112			
Ave. Annual Outflow Volume	ac-ft	42,243		Surface Discharges Only	
Mean TP Conc. In Outflows	mg/l	0.0710			

In the above analysis,

- Average annual evapotranspiration was limited to that occurring with stages above the ground surface.
- The TP concentration in rainfall was assigned at 10 ppb attached to rainfall, plus a dry fall of 20 mg/m^2-yr. Due to surface inflows over a relatively large reservoir surface area, the rainfall load represented a significant source of TP inflow, and thus increased the outflow concentrations over that of the inflow.
- The term "Water Balance Adjustment and Exfiltration" includes both directly estimated seepage losses and outflows from the reservoir (evapotranspiration and subsurface discharges) on days when the reservoir stage is at or below the ground surface.
- The wet period fraction was taken as the number of days over the 31-year period of simulation when the reservoir stage was above ground surface divided by the total number of days in the simulation.
- The mean depth was computed as the average depth of the reservoir on days when the reservoir stage was above the ground surface.

The daily simulation of Compartment C is contained in a furnished Excel file "Compartment C Base.xls". As indicated in Table 5.12, the estimated flow-weighted mean TP concentration in reservoir outflows exceeds that in the inflows, due to the disproportionate atmospheric loading as compared to the pumped inflows.

Subsurface discharges from Compartments C to STA-6 were considered as analogous to seepage outflows, and were assigned a mean TP concentration of 20 ppb.

5.2.2 STA-5, 6 Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Baseline 2015-2056 Conditions for STA-5,6. Daily inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of that condition are included in Excel files "5FU_Data.xls" and "6FU_Data.xls".

Inflow Volumes and TP Loads: Daily inflow volumes to STA-5, 6 were taken from a District-furnished Excel files ("sta5win.xls" and "sta6in.xls" both dated March 7, 2002). Daily inflow TP concentrations by source (other than inflows from Compartment C) were assigned at values equal to those used in analysis of existing conditions at STA-5, 6. A summary of the estimated average annual inflow volumes and loads to STA-5, 6 under the Baseline 2015-2056 condition is presented in Tables 5.13 and 5.14.

Table 5.13 Estimated Inflows, 1965-1995, STA-5 Baseline 2015-2056 Analysis

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
C-139 Basin	147,024	32.33	178
Total Average Annual Inflows	**147,024**	**32.33**	**178**

Table 5.14 Estimated Inflows, 1965-1995, STA-6 Baseline 2015-2056 Analysis

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
USSC Inflow	11,944	1.18	80
C-139 Basin	2,680	0.74	224
Lake Okeechobee Water Supply	638	0.05	66
STA-6 Inflow from C, surface	42,242	3.70	71
STA-6 Inflow from C, subsurface	3,086	0.08	20
Total Average Annual Inflows	**60,590**	**5.75**	**77**

Estimated average annual inflow volumes and TP loads under Baseline 2015-2056 condition to STA-5 increased 11.3% and 11.3%, respectively, and to STA-6 increased 59.9% and 42.3%, respectively, from those estimated for Existing Conditions (Baseline 2007-2015).

Daily Rainfall and Evapotranspiration were assigned equal to those reflected in the analysis of Existing Conditions for STA-5, 6.

5.2.3 Summary of Input Variables

All input variables for analysis of the Baseline 2015-2056 Condition at STA-5, 6 were assigned at values identical to those employed in the Existing Conditions (Baseline 2007-2014) analysis for STA-5, 6. Those input variables are defined in Excel worksheets entitled “Baseline 2015-2056” included in the workbook “5FU_Data.xls” and “6FU_Data.xls”.

5.2.4 Results of DMSTA Analysis for Baseline 2015-2056

Detailed listings of input variables employed in the analysis of the Baseline 2015-2056 Condition for STA-5, 6, together with detailed listings of computed output variables resulting from that analysis, are presented in Tables 5.15 and 5.16 (which consist of screen information taken directly from the DMSTA output files).

Table 5.15 Results of DMSTA Analysis, Baseline 2015-2056 STA-5 Design

Input Variable	Units	Value
Design Case Name	-	Future
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Future, 100% Emergent except Cell 1B--SAV_C4 **Filename:** 5FU_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	45.7
Flow-Wtd Conc - Without Bypass	ppb	45.7
Geometric Mean Conc	ppb	35.9
95th Percentile Conc	ppb	55.5
Freq Cell Outflow > 10 ppb	%	100%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B		
Vegetation Type	------->	EMERG	SAV_C4	EMERG	EMERG		
Inflow Fraction	-	0.5	0	0.5	0		
Downstream Cell Number	-	2	0	4	0		
Surface Area	km2	3.379	4.937	3.379	4.937		
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	60	40	40		
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78		
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0033		
Outflow Seepage Control Elev	cm	-46	-38	-46	-38		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*15.66*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.16	11.74	17.55	23.13			23.13
Run Date	-	05/28/02	05/28/02	05/28/02	05/28/02			05/28/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1A	1B	2A	2B			Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow			-
Surface Area	km2	3.379	4.937	3.379	4.937			16.6
Mean Water Load	cm/d	7.4	5.0	7.4	5.0			3.0
Max Water Load	cm/d	55.5	37.6	55.5	37.6			22.6
Inflow Volume	hm3/yr	90.8	89.4	90.8	89.4			181.5
Inflow Load	kg/yr	16176.3	10441.4	16176.3	10378.5			32352.6
Inflow Conc	ppb	178.2	116.8	178.2	116.1			178.2
Treated Outflow Volume	hm3/yr	89.4	87.4	89.4	86.3			173.7
Treated Outflow Load	kg/yr	10441.4	1683.8	10378.5	6250.1			7933.9
Treated FWM Outflow Conc	ppb	116.8	19.3	116.1	72.4			45.7
Total FWM Outflow Conc	ppb	116.8	19.3	116.1	72.4			45.7
Surface Outflow Load Reduc	%	35.5%	83.9%	35.8%	39.8%			75.5%
Outflow Geometric Mean - Daily	ppb	126.5	12.2	126.3	68.1			36.9
Outflow Geo Mean - Composites	ppb	125.9	11.5	125.6	67.3			35.9
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%			97%

Table 5.16 Results of DMSTA Analysis, Baseline 2015-2056 STA-6 Design

Case Description: Existing, 100% Emergent

Filename: 6FU_Data.xls

Input Variable	Units	Value
Design Case Name	-	Future
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.2%
Flow-Wtd Conc - With Bypass	ppb	30.5
Flow-Wtd Conc - Without Bypass	ppb	30.5
Geometric Mean Conc	ppb	25.2
95th Percentile Conc	ppb	35.0
Freq Cell Outflow > 10 ppb	%	100%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	2	4	3	5		
Vegetation Type	------->	EMERG	EMERG	EMERG	EMERG		
Inflow Fraction	-	0.6	0	0.11	0.29		
Downstream Cell Number	-	2	0	0	0		
Surface Area	km2	2.242	3.363	0.991	2.639		
Mean Width of Flow Path	km	2.34	2.32	0.61	1.31		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	40	40	40		
Outflow Coefficient - Exponent	-	1.67	1.67	3.08	4.16		
Outflow Coefficient - Intercept	-	0.18	0.2	0.63	0.26		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0059	0.0017	0	0		
Outflow Seepage Control Elev	cm	-46	-46	0	0		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0	0		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*16*	*15.66*	*15.66*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.03	11.61	17.58	23.29			23.29
Run Date	-	06/11/02	06/11/02	06/11/02	06/11/02			06/11/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		2	4	3	5			Total Outflow
Downstream Cell Label		4	Outflow	Outflow	Outflow			-
Surface Area	km2	2.242	3.363	0.991	2.639			9.2
Mean Water Load	cm/d	5.5	3.5	2.3	2.2			2.2
Max Water Load	cm/d	74.8	49.9	31.0	30.7			30.3
Inflow Volume	hm3/yr	44.9	42.5	8.2	21.7			74.8
Inflow Load	kg/yr	3407.3	2111.7	624.7	1646.9			5678.9
Inflow Conc	ppb	75.9	49.7	75.9	75.9			75.9
Treated Outflow Volume	hm3/yr	42.5	41.4	8.2	21.6			71.1
Treated Outflow Load	kg/yr	2111.7	1196.5	297.2	675.5			2169.1
Treated FWM Outflow Conc	ppb	49.7	28.9	36.3	31.3			30.5
Total FWM Outflow Conc	ppb	49.7	28.9	36.3	31.3			30.5
Surface Outflow Load Reduc	%	38.0%	43.3%	52.4%	59.0%			61.8%
Outflow Geometric Mean - Daily	ppb	43.0	24.9	29.5	23.9			26.1
Outflow Geo Mean - Composites	ppb	43.2	25.1	29.5	24.5			25.2
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%			100%

Condensed summaries of the results of the analyses are presented in Tables 5.17 and 5.18.

Table 5.17 Discharge Summary, STA-5 Baseline 2015-2056 Design

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	173.7
Average Annual Outflow Volume	Ac-ft/yr	140,800
Average Annual Outflow TP Load	Kg/yr	7,933.9
Flow-weighted Mean TP Concentration	ppb	46
Geometric Mean TP Concentration, weekly composites	ppb	36

Table 5.18 Discharge Summary, STA-6 Baseline 2015-2056 Design

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	71.1
Average Annual Outflow Volume	Ac-ft/yr	57,600
Average Annual Outflow TP Load	Kg/yr	2,169.1
Flow-weighted Mean TP Concentration	ppb	31
Geometric Mean TP Concentration, weekly composites	ppb	25

Estimated average annual outflow volumes and TP loads under Baseline 2015-2056 condition from STA-5 increased 11.8% and 14.5%, respectively, and from STA-6 increased 63.4% and 76.3%, respectively, from those estimated for Existing Conditions (Baseline 2007-2015).

5.3 STA-5, 6 Baseline Condition for Evaluation of Alternatives

The Evaluation Methodology requires a comparison of the performance of various alternatives for improved treatment performance in STA-5, 6 to a Baseline condition. The Baseline condition at STA-5, 6 consists of a combination of Existing Conditions (Baseline

2007-2014) and the Baseline 2015-2056 Conditions. The performance of STA-5, 6 under Existing conditions is applied to the period 2007-2014 (8 years). The performance of STA-5, 6 under Baseline (2015-2056) conditions is applied to the period 2015-2056 (42 years). Tables 5.19 and 5.20 present a summary of the Baseline discharges from STA-5,6 against which discharges from the various alternatives will be evaluated.

Table 5.19 STA-5 Baseline Total Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	125,900	6,930.5	1,007,200	55,444
2015	2056	140,800	7,933.9	5,913,600	333,224
2007	**2056**	**138,400**	**7,773.4**	**6,920,800**	**388,668**
Flow-weighted mean TP Concentration in Discharges, ppb					**46**

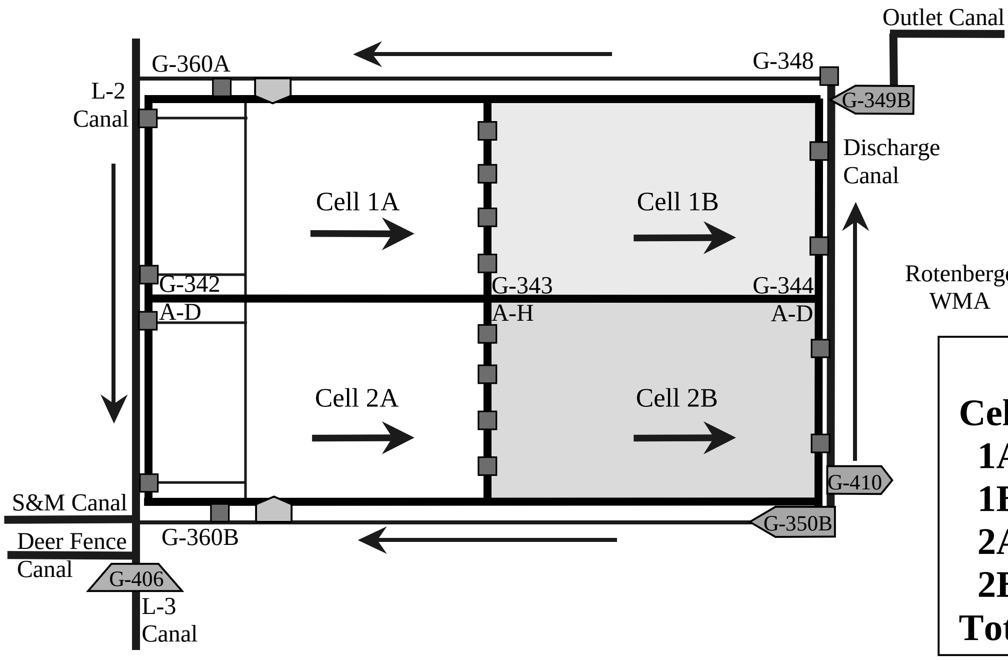
Table 5.20 STA-6 Baseline Total Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	35,300	1,230.3	282,400	9,842
2015	2056	57,600	2,169.1	2,419,200	91,102
2007	**2056**	**54,000**	**2,018.9**	**2,701,600**	**100,944**
Flow-weighted mean TP Concentration in Discharges, ppb					**30**

5.4 STA-5 ,6 Alternative No. 1

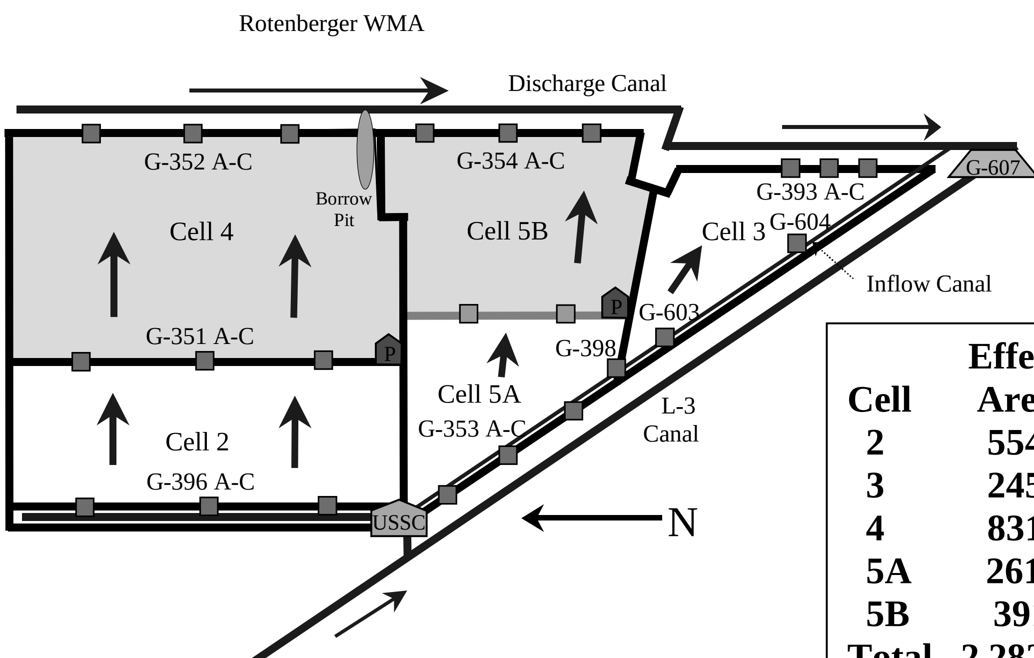
Under Alternative No. 1, STA-5, 6 would be modified to optimize their performances, with completion of all modifications and placement into service of the modified treatment area occurring in 2014. For this analysis, that optimization is considered to consist of the conversion of Cell 2B of STA-5 and Cell 4 of STA-6 from emergent vegetation to Submerged Aquatic Vegetation (SAV). In addition, the downstream 391 acres (60%) of STA-6 Cell 5 would also be converted to SAV.

Schematic designs of STA-5 and STA-6 under Alternative 1, are presented in Figures 5.4 and 5.5.



Cell	Effective Area (ac)
1A	835
1B	1,220
2A	835
2B	1,220
Total	4,110 ac

Figure 5.4. Schematic of STA-5 under Alternative 1



Cell	Effective Area (ac)
2	554
3	245
4	831
5A	261
5B	391
Total	2,282 ac

Figure 5.5. Schematic of STA-6 under Alternative 1

5.4.1 Treatment Analysis Input Data Summary

As this alternative is considered as complete in 2014, inflows to the modified treatment area would be consistent with those projected for the Baseline 2015-2056 condition (e.g., estimated inflows following completion of the EAA Storage Reservoir, Phase 1 and 2). Accordingly, inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 1 are taken from the "5FU_Data.xls" and "6FU_Data.xls" Excel files. Inflow volumes and TP loads are identical to those summarized in Tables 5.13 and 5.14.

5.4.2 Summary of Input Variables for Treatment Analysis

Other than as discussed below, input variables employed in the analysis of Alternative 1 for STA-5, 6 are identical to those included in the Baseline 2015-2056 Condition analysis.

- Cell 5 of STA-6 was subdivided into two cells, Cell 5A (261 acres) and Cell 5B (391 acres).
- The Outflow Control Depth in STA-5 Cell 2B and STA-6 Cells 4 and 5b was modified from 40 cm to 60 cm.
- The vegetation type in in STA-5 Cell 2B and STA-6 Cells 4 and 5b was revised from "Emergent" to "SAV_C4", and the associated default treatment parameters of DMSTA were employed in the analysis.
- The outflow coefficient intercept "a" for Cell 5A & 5B was recalculated for hydraulics of the 40/60 area split—both average to the previous footprint "a".

5.4.3 Results of DMSTA Analysis for Alternative 1

Detailed listings of input variables employed in the analysis of Alternative 1 for STA-5, 6, together with detailed listings of computed output variables resulting from those analyses, are presented in Tables 5.23 and 5.24 (which consist of screen information taken directly from the DMSTA output file).

A condensed summary of the results of the analysis is presented in Tables 5.21 and 5.22, which are considered reflective of the long-term treatment performance of STA-5, 6 following full implementation of Alternative 1.

Table 5.21 Discharge Summary, STA-5 Alternative 1

Parameter	**Units**	**Value**
Average Annual Outflow Volume	Hm^3/yr	173.1
Average Annual Outflow Volume	Ac-ft/yr	140,300
Average Annual Outflow TP Load	Kg/yr	3,340.2
Flow-weighted Mean TP Concentration	ppb	19
Geometric Mean TP Concentration, weekly composites	ppb	12

Table 5.22 Discharge Summary, STA-6 Alternative 1

Parameter	**Units**	**Value**
Average Annual Outflow Volume	Hm^3/yr	71.0
Average Annual Outflow Volume	Ac-ft/yr	57,600
Average Annual Outflow TP Load	Kg/yr	1,197.1
Flow-weighted Mean TP Concentration	ppb	17
Geometric Mean TP Concentration, weekly composites	ppb	10

Table 5.23 Results of DMSTA Analysis, STA-5 Alternative 1

Case Description: Cells 1A & 2A--Emergent & Cells 1B & 2B--SAV_C4 **Filename:** 5FU_Data.xls

Input Variable	Units	Value
Design Case Name	-	Alt1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	19.3
Flow-Wtd Conc - Without Bypass	ppb	19.3
Geometric Mean Conc	ppb	11.5
95th Percentile Conc	ppb	25.1
Freq Cell Outflow > 10 ppb	%	66%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B		
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4		
Inflow Fraction	-	0.5	0	0.5	0		
Downstream Cell Number	-	2	0	4	0		
Surface Area	km2	3.379	4.937	3.379	4.937		
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	60	40	60		
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78		
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0033		
Outflow Seepage Control Elev	cm	-46	-38	-46	-38		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.26	12.07	17.61	23.16			23.16
Run Date	-	05/28/02	05/28/02	05/28/02	05/28/02			05/28/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1A	1B	2A	2B			Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow			-
Surface Area	km2	3.379	4.937	3.379	4.937			16.6
Mean Water Load	cm/d	7.4	5.0	7.4	5.0			3.0
Max Water Load	cm/d	55.5	37.6	55.5	37.6			22.6
Inflow Volume	hm3/yr	90.8	89.4	90.8	89.4			181.5
Inflow Load	kg/yr	16176.3	10441.4	16176.3	10378.5			32352.6
Inflow Conc	ppb	178.2	116.8	178.2	116.1			178.2
Treated Outflow Volume	hm3/yr	89.4	87.4	89.4	85.7			173.1
Treated Outflow Load	kg/yr	10441.4	1683.8	10378.5	1656.4			3340.2
Treated FWM Outflow Conc	ppb	116.8	19.3	116.1	19.3			19.3
Total FWM Outflow Conc	ppb	116.8	19.3	116.1	19.3			19.3
Surface Outflow Load Reduc	%	35.5%	83.9%	35.8%	84.0%			89.7%
Outflow Geometric Mean - Daily	ppb	126.5	12.2	126.3	12.5			12.1
Outflow Geo Mean - Composites	ppb	125.9	11.5	125.6	11.9			11.5
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%			64%

Table 5.24 Results of DMSTA Analysis, STA-6 Alternative 1

Input Variable	Units	Value
Design Case Name	-	Alt1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Cells 2,3 & 5a--Emergent and Cells 4 & 5b--SAV_C4

Filename: 6FU_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.1%
Flow-Wtd Conc - With Bypass	ppb	16.9
Flow-Wtd Conc - Without Bypass	ppb	16.9
Geometric Mean Conc	ppb	9.9
95th Percentile Conc	ppb	21.4
Freq Cell Outflow > 10 ppb	%	29%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	2	4	3	5a	5b	
Vegetation Type	------->	EMERG	SAV_C4	EMERG	EMERG	SAV_C4	
Inflow Fraction	-	0.6	0	0.11	0.29	0	
Downstream Cell Number	-	2	0	0	5	0	
Surface Area	km2	2.242	3.363	0.991	1.056	1.582	
Mean Width of Flow Path	km	2.34	2.32	0.61	1.12	1.48	
Number of Tanks in Series	-	3	3	3	3	3	
Outflow Control Depth	cm	40	60	40	40	60	
Outflow Coefficient - Exponent	-	1.67	1.67	3.08	3.56	5.07	
Outflow Coefficient - Intercept	-	0.18	0.2	0.63	0.29	0.24	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0.0059	0.0017	0	0	0	
Outflow Seepage Control Elev	cm	-46	-46	0	0	0	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0.5	0.5	0	0	0	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*15.66*	*80.10*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.23	11.84	17.74	23.36	28.97		28.97
Run Date	-	06/11/02	06/11/02	06/11/02	06/11/02	06/11/02		06/11/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95		12/31/95
Output Duration	days	11322	11322	11322	11322	11322		11322
Cell Label		2	4	3	5a	5b		Total Outflow
Downstream Cell Label		4	Outflow	Outflow	5b	Outflow		-
Surface Area	km2	2.242	3.363	0.991	1.056	1.582		9.2
Mean Water Load	cm/d	5.5	3.5	2.3	5.6	3.7		2.2
Max Water Load	cm/d	74.8	49.9	31.0	76.7	51.7		30.3
Inflow Volume	hm3/yr	44.9	42.5	8.2	21.7	21.6		74.8
Inflow Load	kg/yr	3407.3	2111.7	624.7	1646.9	1089.5		5678.9
Inflow Conc	ppb	75.9	49.7	75.9	75.9	50.3		75.9
Treated Outflow Volume	hm3/yr	42.5	41.2	8.2	21.6	21.6		71.0
Treated Outflow Load	kg/yr	2111.7	567.7	297.2	1089.5	332.3		1197.1
Treated FWM Outflow Conc	ppb	49.7	13.8	36.3	50.3	15.4		16.9
Total FWM Outflow Conc	ppb	49.7	13.8	36.3	50.3	15.4		16.9
Surface Outflow Load Reduc	%	38.0%	73.1%	52.4%	33.8%	69.5%		78.9%
Outflow Geometric Mean - Daily	ppb	43.0	7.8	29.5	40.4	6.5		13.4
Outflow Geo Mean - Composites	ppb	43.2	7.6	29.5	41.4	7.0		9.9
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	100%	0%		42%

Tables 5.25 and 5.26 summarize the estimated total discharges from STA-5, 6, Alternative 1 over the 50-year period 2007-2056, given that:

- STA-5, 6 will operate under Existing conditions over the period 2007-2014.
- STA-5, 6 will operate under Alternative 1 conditions over the period 2015-2056.

Table 5.25 STA-5 Alt. 1, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	125,900	6,930.5	1,007,200	55,444
2015	2056	140,300	3,340.2	5,892,600	140,288
2007	**2056**	**138,000**	**3,914.6**	**6,899,800**	**195,732**
Flow-weighted mean TP Concentration in Discharges, ppb					**23**

Table 5.26 STA-6 Alt. 1, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	35,300	1,230.3	282,400	9,842
2015	2056	57,600	1,197.1	2,419,200	50,278
2007	**2056**	**54,000**	**1,202.4**	**2,701,600**	**60,120**
Flow-weighted mean TP Concentration in Discharges, ppb					**18**

5.4.4 Opinion of Probable Capital Cost

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 1:

<u>STA-5:</u>

- Herbicide treatment of Cells 2B for removal of emergent macrophyte vegetation to permit development of SAV.

STA-6:

- Construction of approximately 0.8 miles of interior levee, subdividing Cell 5 into Cells 5A and 5B.
- Construction of additional water control structures through the new levee subdividing Cell 5 into Cells 5A and 5B. These structures are assumed to be equivalent in number and character to Structures G-381 (two 8'x8' gated RCB's with telemetric control).
- Extension of an overhead power distribution line from Interior Levee 4, then north along the new levee across Cell 5 (total length of approximately 0.8 miles).
- Small forward-pumping stations along the interior levees between cells in series to permit withdrawal from upstream emergent marsh cells to maintain stages in the downstream SAV cells. Two stations are anticipated. The station pumping from Cell 2 to Cell 4 is assigned a preliminary capacity of 11 cfs (equal to a maximum daily evaporation rate from Cell 4 of 0.24"/day, and an estimated seepage loss from Cell 4 of 0.072"/day). The station pumping from Cell 5A to Cell 5B is assigned a preliminary capacity of 4 cfs (equal to a maximum daily evaporation rate from Cell 5B of 0.24"/day).
- Herbicide treatment of Cells 4 and 5B for removal of emergent macrophyte vegetation to permit development of SAV.

An opinion of the probable capital cost for Alternative 1 is presented in Tables 5.27 and 5.28.

Table 5.27 Opinion of Probable Capital Cost, STA-5 Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Eradication of Existing Vegetation	1220	ac	$200	$244,000	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$244,000**	**244,000**
Planning, Engineering & Design		10 %			$24,400	**24,000**
Program & Construction Management		10 %			$24,400	**24,000**
Total Estimated Cost, Without Contingency					**$292,800**	**292,000**
Contingency		30 %			$87,840	**88,000**
TOTAL ESTIMATED CAPITAL COST					**$380,640**	**380,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

Table 5.28 Opinion of Probable Capital Cost, STA-6 Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee, 7' height (Excludes Blasting Costs)	0.8	Mi.	$390,000	$312,000	Unit cost from Evaluation Methodology
2	New Water Control Structures (10'x8', Gated)	2	Ea.	$200,000	$400,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
3	Water Control Structure Electrical (Includes Telemetry)	2	Ea.	$43,000	$86,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
4	Stilling Wells (Includes Electrical and Telemetry)	2	Ea.	$9,000	$18,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
5	Electrical Power Distribution	0.8	Mi.	$80,000	$64,000	Unit cost from Evaluation Methodology
6	Pumping Station, Cells 5A-5B	4	cfs	$7,600	$30,400	Unit cost from Evaluation Methodology
7	Pumping Station, Cells 2-4	11	cfs	$7,600	$83,600	Unit cost from Evaluation Methodology
8	Eradication of Existing Vegetation	1222	ac	$200	$244,400	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$1,238,400**	**1,240,000**
Planning, Engineering & Design		10 %			$123,840	**120,000**
Program & Construction Management		10 %			$123,840	**120,000**
Total Estimated Cost, Without Contingency					**$1,486,080**	**1,480,000**
Contingency		30 %			$445,824	**450,000**
TOTAL ESTIMATED CAPITAL COST					**$1,931,904**	**1,930,000**

5.4.5 Opinion of Probable Annual Costs for Operation & Maintenance

The following is a summary listing of the anticipated incremental operation and maintenance requirements for Alternative 1 (e.g., requirements in addition to those for operation of maintenance of STA-5,6 as presently designed):

STA-5:

- Additional herbicide treatment of Cells 2B for control of invasive species and emergent macrophyte vegetation. This item includes both:

  - Annual costs to spray for invasive species.
  - Additional costs for post-drought eradication of undesirable species.

STA-6:

- Maintenance of approximately 0.8 additional miles of interior levee.
- Operation and maintenance of the additional water control structures through the new levee subdividing Cell 5 into Cells 5A and 5B.
- Operation and maintenance of the small forward-pumping stations along the interior levee between Cell 5A and 5B, and between 2 and 4, included in the design to permit withdrawal from upstream emergent marsh cells to maintain stages in the downstream SAV cells. The pumps are assumed to be driven by electric motors. The unit operating costs are estimated using a power cost of $0.08/kw-hr; an assumed total head of 6 feet; an overall efficiency of 85%; and an assigned utilization equal to 10% of the overall time. The resultant power consumption is 0.43 kw/cfs, or 3,770 kw-hr/cfs/yr., yielding an approximate average annual cost of $300/yr/cfs.
- Additional herbicide treatment of Cells 4 and 5B for control of invasive species and emergent macrophyte vegetation. This item includes both:
  - Annual costs to spray for invasive species.
  - Additional costs for post-drought eradication of undesirable species.

The February 22, 2002 Draft *Supplemental Technology Standard of Comparison (STSOC) Analysis for Submerged Aquatic Macrophyte/Limerock Technology*, D.B Environmental, presents an estimated cost of $25/acre/year for regular herbicide treatment for control of invasive species, and an additional $10/acre/year for post-drought eradication spraying. Given the inclusion of the available gradient in STA-5 and inclusion of forward-pumping stations in STA-6 for maintenance of stages in the SAV cells, the opinion of probable incremental operation and maintenance cost includes a substantially reduced allowance of $10/acre/year for both those items.

An opinion of the probable incremental operation and maintenance cost for Alternative 1 is presented in Tables 5.29 and 5.30.

Table 5.29 Opinion of Probable Incremental O&M Cost, STA-5 Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Incremental Cost forAnnual Vegetation Control	1220	ac	$10	$12,200	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$12,200**	
Contingency		30 %			$3,660	
TOTAL INCREMENTAL O&M COST					**$15,860**	**$15,000**

Table 5.30 Opinion of Probable Incremental O&M Cost, STA-6 Alternative 1

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee	0.8	Mi.	$1,530	$1,224	Unit cost from Evaluation Methodology
2	New Water Control Structures	2	Ea.	$12,000	$24,000	Unit cost from Evaluation Methodology
3	Mech. Maintenance, Pumping Station	2	Ea.	$10,000	$20,000	Unit cost from Evaluation Methodology
4	Power Consumption, Pumping Station, Cells 5A-5B	4	cfs	$300	$1,200	See text for basis of estimated unit cost
5	Power Consumption, Pumping Station, Cells 2-4	11	cfs	$300	$3,300	See text for basis of estimated unit cost
6	Incremental Cost forAnnual Vegetation Control	1222	ac	$10	$12,220	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$61,944**	
Contingency		30 %			$18,583	
TOTAL INCREMENTAL O&M COST					**$80,527**	**$80,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

5.4.6 Total Present Worth

The total present cost of Alternative 1 is presented in Tables 5.31 and 5.32, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation factor of 3%.

Table 5.31 Total Present Worth, STA-5 Alternative 1

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**03/15/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
Capital Costs						**Present Worth**
Year		**PED**	**P&CM**	**Const.**	**Total**	
2013		$33,222	$33,222	$459,566	$526,009	$266,537
Total Capital Cost					$526,009	$266,537
Incremental Costs for Operation and Maintenance						**Present Worth**
From	**To**			**Total O&M Cost**		
2015	2056				$1,806,807	$237,558
Total Present Worth of Alternative						**$504,095**

Table 5.32 Total Present Worth, STA-6 Alternative 1

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
Capital Costs						**Present Worth**
Year		**PED**	**P&CM**	**Const.**	**Total**	
2012		$161,270	$80,635	$1,135,609	$1,377,514	$950,733
2013			$83,054	$1,169,678	$1,252,732	$812,795
Total Capital Cost					$2,630,246	$1,763,528
Incremental Costs for Operation and Maintenance						**Present Worth**
From	**To**			**Total O&M Cost**		
2015	2056				9,636,306	$1,177,465
Total Present Worth of Alternative						**$2,940,993**

5.5 STA-5, 6 Alternative No. 2

Under Alternative No. 2, STA-5, 6 would be modified to optimize their performance, with completion of all modifications and placement into service of the modified treatment area occurring prior to the end of 2006. For this analysis, that optimization is considered to consist of the conversion of Cell 2B of STA-5 and Cell 4 of STA-6 from emergent vegetation to Submerged Aquatic Vegetation (SAV). In addition, the downstream 391 acres (60%) of Cell 5 would also be converted to SAV. Essentially, Alternative 2 would be identical to Alternative 1, with the exception of the proposed completion schedule.

5.5.1 Treatment Analysis Input Data Summary

As this alternative is considered as complete in 2006, inflows to the modified treatment area would be consistent with those projected for the Existing condition (e.g., estimated inflows prior to completion of the EAA Storage Reservoir, Phase 1 and 2 and other significant CERP projects) through 2014. After that date, inflows would be consistent with those for Alternative 1. Accordingly, inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 2 are taken from the "5EX_Data.xls" and "6EX_Data.xls" Excel files. Inflow volumes and TP loads are identical to those summarized in Tables 5.1 and 5.2.

5.5.2 Summary of Input Variables for Treatment Analysis

Input variables employed in the analysis of Alternative 2 for STA-5, 6 are identical to those established for the Alternative 1 analysis.

5.5.3 Results of DMSTA Analysis for Alternative 2

A detailed listing of input variables employed in the analysis of Alternative 2 for STA-5, 6, together with a detailed listing of computed output variables resulting from that analysis, is presented in Tables 5.35 and 5.36 (which consists of screen information taken directly from the DMSTA output file).

A condensed summary of the results of the analysis is presented in Tables 5.33 and 5.34, which is considered reflective of the short-term treatment performance of STA-5, 6 prior to the end of 2014. After 2014, the performance of Alternative 2 would be considered identical to that for Alternative 1.

Table 5.33 Discharge Summary, STA-5 Alternative 2#

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	154.8
Average Annual Outflow Volume	Ac-ft/yr	125,500
Average Annual Outflow TP Load	Kg/yr	3,031.8
Flow-weighted Mean TP Concentration	Ppb	20
Geometric Mean TP Concentration, weekly composites	Ppb	10

#see Table 5.21 for long-term results of STA-5 Alternative 2

Table 5.34 Discharge Summary, STA-6 Alternative 2#

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	43.3
Average Annual Outflow Volume	Ac-ft/yr	35,100
Average Annual Outflow TP Load	Kg/yr	746.3
Flow-weighted Mean TP Concentration	Ppb	17
Geometric Mean TP Concentration, weekly composites	Ppb	10**

**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.
#see Table 5.22 for long-term results of STA-6 Alternative 2

Table 5.35 Results of DMSTA Analysis, STA-5 Alternative 2

Input Variable	Units	Value	Case Description:	Filename:	5EX_Data.xls
Design Case Name	-	Alt2	Cells 1A & 2A--Emergent & Cells 1B & 2B--SAV_C4		
Starting Date for Simulation	-	01/01/65			
Ending Date for Simulation	-	12/31/95			
Starting Date for Output	-	01/01/65			
Steps Per Day	-	3	**Output Variable**	**Units**	**Value**
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	-0.1%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	19.6
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	19.6
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	10.4
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	24.9
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	62%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B		
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4		
Inflow Fraction	-	0.5	0	0.5	0		
Downstream Cell Number	-	2	0	4	0		
Surface Area	km2	3.379	4.937	3.379	4.937		
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	60	40	60		
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78		
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0033		
Outflow Seepage Control Elev	cm	-46	-38	-46	-38		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.13	11.65	17.49	23.03			23.03
Run Date	-	05/28/02	05/28/02	05/28/02	05/28/02			05/28/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1A	1B	2A	2B			Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow			-
Surface Area	km2	3.379	4.937	3.379	4.937			16.6
Mean Water Load	cm/d	6.6	4.4	6.6	4.4			2.7
Max Water Load	cm/d	60.0	40.5	60.0	40.4			24.4
Inflow Volume	hm3/yr	81.5	80.2	81.5	80.2			163.1
Inflow Load	kg/yr	14531.8	9296.2	14531.8	9241.2			29063.6
Inflow Conc	ppb	178.2	115.9	178.2	115.3			178.2
Treated Outflow Volume	hm3/yr	80.2	78.2	80.2	76.6			154.8
Treated Outflow Load	kg/yr	9296.2	1528.1	9241.2	1503.6			3031.8
Treated FWM Outflow Conc	ppb	115.9	19.5	115.3	19.6			19.6
Total FWM Outflow Conc	ppb	115.9	19.5	115.3	19.6			19.6
Surface Outflow Load Reduc	%	36.0%	83.6%	36.4%	83.7%			89.6%
Outflow Geometric Mean - Daily	ppb	117.8	11.2	117.7	11.7			11.2
Outflow Geo Mean - Composites	ppb	117.5	10.4	117.4	10.9			10.4
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%			59%

Table 5.36 Results of DMSTA Analysis, STA-6 Alternative 2

Input Variable	Units	Value
Design Case Name	-	Alt2
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Cells 2,3 & 5a--Emergent and Cells 4 & 5b--SAV_C4 **Filename:** 6EX_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	17.3
Flow-Wtd Conc - Without Bypass	ppb	17.3
Geometric Mean Conc	ppb	8.9
95th Percentile Conc	ppb	22.1
Freq Cell Outflow > 10 ppb	%	14%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	2	4	3	5a	5b	
Vegetation Type	------->	EMERG	SAV_C4	EMERG	EMERG	SAV_C4	
Inflow Fraction	-	0.6	0	0.11	0.29	0	
Downstream Cell Number	-	2	0	0	5	0	
Surface Area	km2	2.242	3.363	0.991	1.056	1.582	
Mean Width of Flow Path	km	2.34	2.32	0.61	1.12	1.48	
Number of Tanks in Series	-	3	3	3	3	3	
Outflow Control Depth	cm	40	60	40	40	60	
Outflow Coefficient - Exponent	-	1.67	1.67	3.08	3.56	5.07	
Outflow Coefficient - Intercept	-	0.18	0.2	0.63	0.29	0.24	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0.0059	0.0017	0	0	0	
Outflow Seepage Control Elev	cm	-46	-46	0	0	0	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0.5	0.5	0	0	0	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*15.66*	*80.10*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	7.87	14.00	20.19	26.39	32.81		32.81
Run Date	-	06/11/02	06/11/02	06/11/02	06/11/02	06/11/02		06/11/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95		12/31/95
Output Duration	days	11322	11322	11322	11322	11322		11322
Cell Label		2	4	3	5a	5b		Total Outflow
Downstream Cell Label		4	Outflow	Outflow	5b	Outflow		-
Surface Area	km2	2.242	3.363	0.991	1.056	1.582		9.2
Mean Water Load	cm/d	3.4	2.1	1.4	3.5	2.3		1.4
Max Water Load	cm/d	86.3	58.9	35.8	88.5	61.1		34.9
Inflow Volume	hm3/yr	28.1	25.9	5.1	13.6	13.5		46.8
Inflow Load	kg/yr	2427.3	1274.9	445.0	1173.2	655.8		4045.4
Inflow Conc	ppb	86.5	49.3	86.5	86.5	48.5		86.5
Treated Outflow Volume	hm3/yr	25.9	24.7	5.1	13.5	13.4		43.3
Treated Outflow Load	kg/yr	1274.9	372.0	174.9	655.8	199.3		746.3
Treated FWM Outflow Conc	ppb	49.3	15.1	34.3	48.5	14.8		17.3
Total FWM Outflow Conc	ppb	49.3	15.1	34.3	48.5	14.8		17.3
Surface Outflow Load Reduc	%	47.5%	70.8%	60.7%	44.1%	69.6%		81.6%
Outflow Geometric Mean - Daily	ppb	39.5	7.3	25.3	38.0	5.6		12.8
Outflow Geo Mean - Composites	ppb	40.1	7.0	25.5	38.7	6.0		8.9
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	100%	0%		33%

Tables 5.37 and 5.38 summarize the estimated total discharges from STA-5, 6 Alternative 2 over the 50-year period 2007-2056, given that:

- STA-5, 6 will operate under Alternative 2 conditions over the period 2007-2014.
- STA-5, 6 will operate under Alternative 1 conditions over the period 2015-2056.

Table 5.37 STA-5 Alt. 2, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	125,500	3,031.8	1,004,000	24,254
2015	2056	140,300	3,340.2	5,892,600	140,288
2007	**2056**	**137,900**	**3,290.8**	**6,896,600**	**164,542**
Flow-weighted mean TP Concentration in Discharges, ppb					**19**

Table 5.38 STA-6 Alt. 2, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	35,100	746.3	280,800	5,970
2015	2056	57,600	1,197.1	2,419,200	50,278
2007	**2056**	**54,000**	**1,125.0**	**2,700,000**	**56,248**
Flow-weighted mean TP Concentration in Discharges, ppb					**17**

5.5.4 Total Present Worth

Capital costs and incremental operation and maintenance costs for Alternative 2 are considered identical to those for Alternative 1, with the only variation consisting of the implementation schedule. The total present worth of Alternative 2 is presented in Table 5.23, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation factor of 3%.

Table 5.39 Total Present Worth, STA-5 Alternative 2

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**03/15/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present Worth**
Year		**PED**	**P&CM**	**Const.**	**Total**	
2005		$26,225	$26,225	$362,785	$415,236	$344,966
Total Capital Cost					$415,236	$344,966
Incremental Costs for Operation and Maintenance						**Present Worth**
From	**To**	**Annual O&M Cost**		**Total O&M Cost**		
2007	2056		$15,000		$1,961,437	$331,787
Total Present Worth of Alternative						**$676,753**

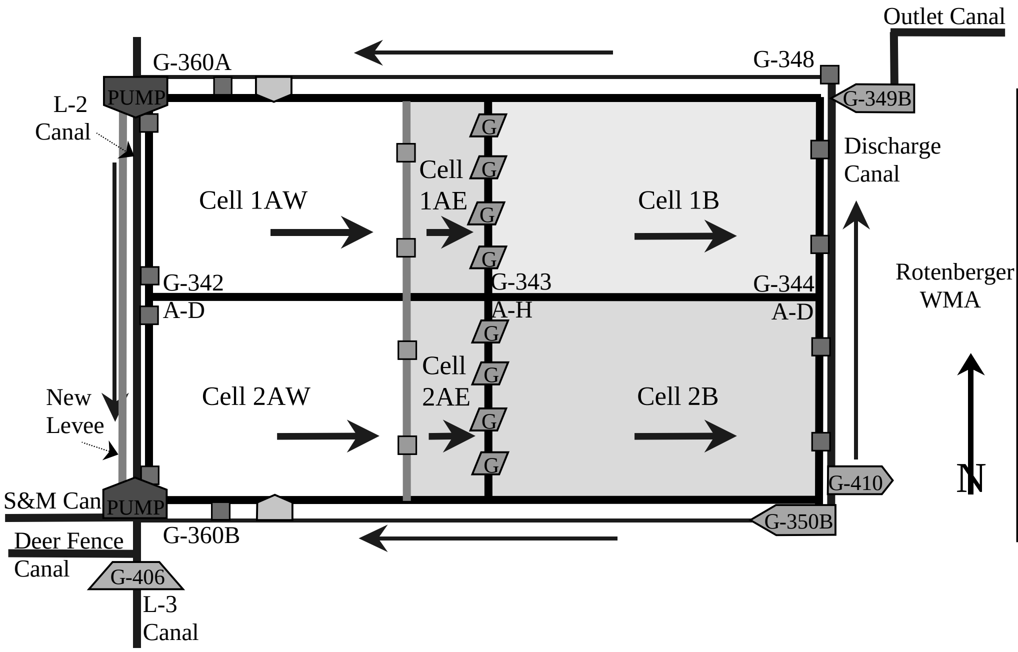
Table 5.40 Total Present Worth, STA-6 Alternative 2

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present Worth**
Year		**PED**	**P&CM**	**Const.**	**Total**	
2004		$127,308	$63,654	$896,461	$1,087,423	$960,991
2005			$65,564	$923,354	$988,918	$821,564
Total Capital Cost					$2,076,340	$1,782,555
Incremental Costs for Operation and Maintenance						**Present Worth**
From	**To**			**Total O&M Cost**		
2007	2056				$10,460,999	$1,649,900
Total Present Worth of Alternative						**$3,432,455**

5.6 STA-5, 6 Alternative No. 3

Under Alternative No. 3, STA-5 would be modified to optimize its performance, with completion of all modifications and placement into service of the modified treatment area occurring prior to the end of 2014. In addition, the effective treatment area of STA-5 would be expanded to include all lands east of the L-2 Borrow Canal. Upon that expansion, <u>all</u> discharges from the C-139 Basin would be directed to STA-5 for treatment, thereby reducing inflow volumes and loads to STA-6; this redirection of flows and added modifications reduces the uncertainty of applicability of SFWWM-generated inflows to STA-5

Schematic designs of STA-5 and STA-6 under Alternative 1, are presented in Figures 5.6 and 5.7.



Cell	Effective Area (ac)
1AW	900
1AE	300
1B	1,220
2AW	900
2AE	300
2B	1,220
Total	4,840 ac

Figure 5.6. Schematic of STA-5 under Alternative 3

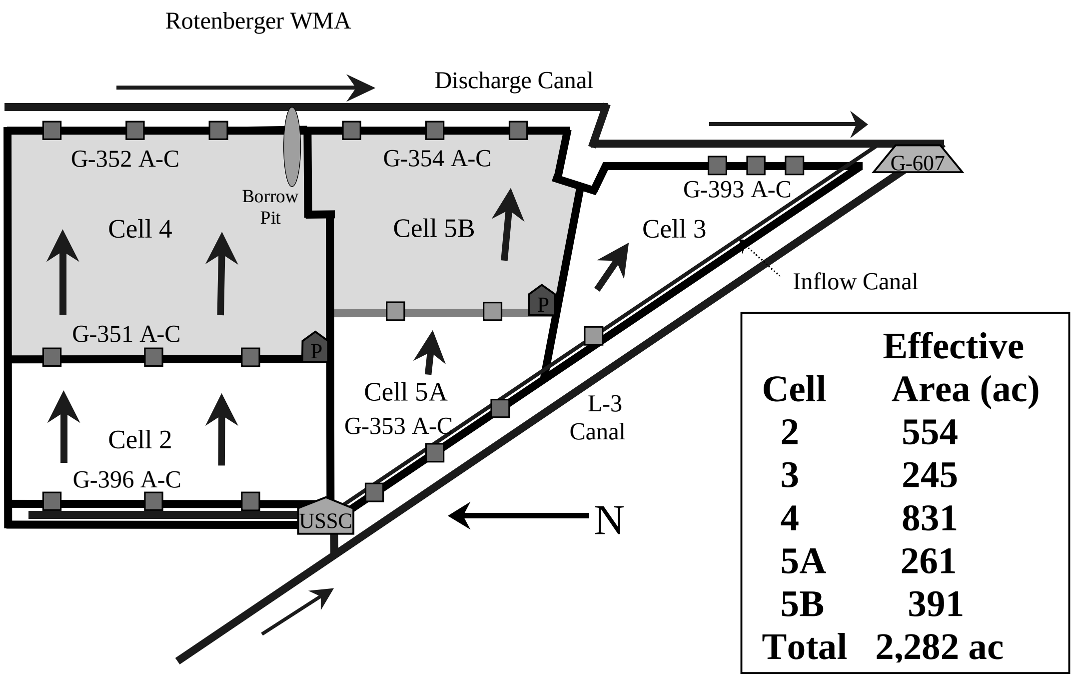


Figure 5.7. Schematic of STA-6 under Alternative 3

As earlier discussed, STA-6 would, under Alternative 1, be expected to achieve the target outflow concentration (Geometric Mean of 10 ppb). The redirection of C-139 inflows from STA-6 to STA-5 could therefore theoretically permit a reduction in the overall effective treatment area of STA-6. (e.g., a reduction in size of the yet-to-be constructed Section 2).

Under Alternative 3, the optimization of STA-5 would include:

- Conversion of Cell 2B to SAV.
- Expansion of STA-5 west to Levee L-2, adding 730 acres to the effective area of STA-5 The expanded area would be further compartmentalized through addition of transverse levees and control structures.
- The conversion of an additional 600 acres to SAV (300 acres in each of the two parallel flow paths)
- Acquisition of lands west of L-2 to permit construction of a containment levee.

Upon completion, each of the two parallel flow paths of STA-5 would consist of three cells in series, with the easternmost two cells (63% of the total area) developed in SAV, and westernmost (upstream) cells developed as emergent macrophyte marsh.

The optimization of STA-6 would include:

- A reduction of approximately 20% (277 acres) in the effective area of STA-6 Section 2. That reduction would be applied to both cells of Section 2.
- Modification of STA-6, Section 1 as described for Alternative 1.
- The downstream cell of Section 2 would be converted to SAV, similar to the conversion defined for Alternative 1.
- The distribution of inflows to the various cells of STA-6 would be adjusted, reducing the inflow fraction to the (all emergent) Cell 3.

5.6.1 Treatment Analysis Input Data Summary

As this alternative is considered as complete in 2014, inflows to the modified treatment area would be consistent with those projected for the Baseline 2015-2056 condition (e.g., estimated inflows following completion of the EAA Storage Reservoir, Phase 1 and 2). Accordingly, inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of Alternative 1 are taken from the “5ALT3_Data.xls” and “6ALT3_Data.xls” Excel files. Inflow volumes and TP loads are summarized in Tables 5.41 and 5.42.

Table 5.41 Estimated Inflows, 1965-1995, STA-5 Alt 3. Analysis

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
C-139 Basin (STA-5 original)	147,024	32.33	178
C-139 Basin (STA-6 original)	2,680	0.74	224
Total Average Annual Inflows to STA-5	**149,704**	**33.07**	**179**

Table 5.42 Estimated Inflows, 1965-1995, STA-6 Alt 3. Analysis

Inflow Source and Description	Average Annual Inflow		Flow-Weighted Mean TP Conc.
	Volume (ac-ft)	TP Load (1,000 kg)	(ppb)
USSC Inflow	11,944	1.18	80
Lake Okeechobee Water Supply	638	0.05	66
STA-6 Inflow from C, surface	42,242	3.70	71
STA-6 Inflow from C, subsurface	3,086	0.08	20
Total Average Annual Inflows	**57,910**	**5.01**	**70**

5.6.2 Summary of Input Variables for Treatment Analysis

Other than as discussed below, input variables employed in the analysis of Alternative 3 for STA-5, 6 are identical to those included in the Alternative 1 analysis.

- The effective treatment area of STA-5 is expanded by 730 acres increasing both “A” cells by 365 acres each, all emergent vegetation. That expansion in effective treatment area would be situated entirely on District-owned lands east of L-2.
- The newly increased STA-5 “A” cells are split into Cells 1AW and 2AW (both 900 acres) and Cells 1AE and 2AE (both 300 acres).
- STA-5 Cells 1AE and 2AE are considered developed in SAV
- STA-5 will receive all C-139 flows originally intended for STA-6
- STA-6 Section 2 area is reduced 20%, equally in both Cells 2 & 4
- Flows within STA-6 are re-distributed from Cell 3 (11% decreased to 5%), to Cells 2/4 (60% increased to 65%), and Cell 5a/b (29% increased to 30%).
- The hydraulics for STA-5 newly-sized “A” Cells is modeled to be similar to Cells 1A and 2A with seepage adjusted for the lengths and different ground elevations found in that area..
- The hydraulics for newly- sized STA-6 Cells 2 and 4 is modeled to be similar to previous estimates with seepage adjusted for the lengths

5.6.3 Results of DMSTA Analysis for Alternative 3

Detailed listings of input variables employed in the analysis of Alternative 3 for STA-5, 6 together with detailed listings of computed output variables resulting from that analysis, are presented in Tables 5.43 and 5.44 (which consist of screen information taken directly from the DMSTA output file).

Table 5.43 Results of DMSTA Analysis, STA-5 Alternative 3

Input Variable	Units	Value	Case Description:	Filename:	5ALT3_Data.xls
Design Case Name	-	Alt3	Cells 1AW & 2AW--Emergent & Cells 1AE, 1B, 2AE & 2B--SAV_C4		
Starting Date for Simulation	-	01/01/65	STA 5 increased by 730 acres		
Ending Date for Simulation	-	12/31/95	38/62 EMER/SAV SPLIT		
Starting Date for Output	-	01/01/65	All C-139 Flows to STA-5		
Steps Per Day	-	3	**Output Variable**	**Units**	**Value**
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	-0.1%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	14.8
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	14.8
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	8.0
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	19.3
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	41%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**
Cell Label	-	1AW	1AE	1B	2AW	2AE	2B
Vegetation Type	------->	EMERG	SAV_C4	SAV_C4	EMERG	SAV_C4	SAV_C4
Inflow Fraction	-	0.5	0	0	0.5	0	0
Downstream Cell Number	-	2	3	0	5	6	0
Surface Area	km2	3.642	1.214	4.937	3.642	1.214	4.937
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56	1.56	1.56
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	60	40	60	60
Outflow Coefficient - Exponent	-	2.8	2.8	2.15	2.91	2.91	1.78
Outflow Coefficient - Intercept	-	1.57	1.57	2.02	1.51	1.51	2.5
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.001	0.003	0.0014	0.001	0.003	0.0033
Outflow Seepage Control Elev	cm	-53	-46	-38	-53	-46	-38
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5	0.5	0.5
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*80.10*	*15.66*	*80.10*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.87	13.58	20.58	28.03	35.10	42.23	42.23
Run Date	-	07/02/02	07/02/02	07/02/02	07/02/02	07/02/02	07/02/02	07/02/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1AW	1AE	1B	2AW	2AE	2B	Total Outflow
Downstream Cell Label		1AE	1B	Outflow	2AE	2B	Outflow	-
Surface Area	km2	3.642	1.214	4.937	3.642	1.214	4.937	19.6
Mean Water Load	cm/d	6.9	20.6	5.0	6.9	20.6	5.0	2.6
Max Water Load	cm/d	62.1	186.3	45.8	62.1	186.3	45.8	23.1
Inflow Volume	hm3/yr	92.4	91.2	90.3	92.4	91.2	90.3	184.8
Inflow Load	kg/yr	16547.7	10499.6	5099.5	16547.7	10435.1	5077.2	33095.3
Inflow Conc	ppb	179.1	115.2	56.5	179.1	114.5	56.2	179.1
Treated Outflow Volume	hm3/yr	91.2	90.3	88.3	91.2	90.3	86.7	175.0
Treated Outflow Load	kg/yr	10499.6	5099.5	1304.5	10435.1	5077.2	1287.3	2591.8
Treated FWM Outflow Conc	ppb	115.2	56.5	14.8	114.5	56.2	14.9	14.8
Total FWM Outflow Conc	ppb	115.2	56.5	14.8	114.5	56.2	14.9	14.8
Surface Outflow Load Reduc	%	36.5%	51.4%	74.4%	36.9%	51.3%	74.6%	92.2%
Outflow Geometric Mean - Daily	ppb	124.1	40.8	8.5	123.8	40.5	8.8	8.5
Outflow Geo Mean - Composites	ppb	123.5	40.3	8.0	123.2	40.1	8.3	8.0
Frequency Outflow Conc > 10 ppb	%	100%	100%	20%	100%	100%	20%	39%

Table 5.44 Results of DMSTA Analysis, STA-6 Alternative 3

Input Variable	Units	Value
Design Case Name	-	Alt3
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Filename: 6ALT3_Data.xls

Cells 2,3 & 5a--Emergent and Cells 4 & 5b--SAV_C4
Cell 2 & 4 -- 80% original size
All C-139 Flows to STA-5

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.2%
Flow-Wtd Conc - With Bypass	ppb	14.7
Flow-Wtd Conc - Without Bypass	ppb	14.7
Geometric Mean Conc	ppb	8.0
95th Percentile Conc	ppb	19.8
Freq Cell Outflow > 10 ppb	%	28%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	2	4	3	5a	5b	
Vegetation Type	------->	EMERG	SAV_C4	EMERG	EMERG	SAV_C4	
Inflow Fraction	-	0.65	0	0.05	0.3	0	
Downstream Cell Number	-	2	0	0	5	0	
Surface Area	km2	1.793	2.691	0.991	1.056	1.582	
Mean Width of Flow Path	km	1.87	1.86	0.61	1.12	1.48	
Number of Tanks in Series	-	3	3	3	3	3	
Outflow Control Depth	cm	40	60	40	40	60	
Outflow Coefficient - Exponent	-	1.67	1.67	3.08	3.56	5.07	
Outflow Coefficient - Intercept	-	0.22	0.25	0.63	0.29	0.24	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0.0073	0.0022	0	0	0	
Outflow Seepage Control Elev	cm	-46	-46	0	0	0	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0.5	0.5	0	0	0	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*15.66*	*80.10*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	7.29	14.29	20.94	27.42	34.45		34.45
Run Date	-	06/26/02	06/26/02	06/26/02	06/26/02	06/26/02		06/26/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95		12/31/95
Output Duration	days	11322	11322	11322	11322	11322		11322
Cell Label		2	4	3	5a	5b		Total Outflow
Downstream Cell Label		4	Outflow	Outflow	5b	Outflow		-
Surface Area	km2	1.793	2.691	0.991	1.056	1.582		8.1
Mean Water Load	cm/d	7.1	4.5	1.0	5.6	3.7		2.4
Max Water Load	cm/d	66.7	33.4	9.3	52.3	29.7		22.7
Inflow Volume	hm3/yr	46.5	44.1	3.6	21.4	21.4		71.5
Inflow Load	kg/yr	3208.5	2144.5	246.8	1480.8	969.0		4936.2
Inflow Conc	ppb	69.0	48.6	69.0	69.0	45.3		69.0
Treated Outflow Volume	hm3/yr	44.1	42.8	3.5	21.4	21.3		67.7
Treated Outflow Load	kg/yr	2144.5	625.6	80.3	969.0	291.2		997.0
Treated FWM Outflow Conc	ppb	48.6	14.6	22.7	45.3	13.7		14.7
Total FWM Outflow Conc	ppb	48.6	14.6	22.7	45.3	13.7		14.7
Surface Outflow Load Reduc	%	33.2%	70.8%	67.5%	34.6%	70.0%		79.8%
Outflow Geometric Mean - Daily	ppb	43.6	8.7	17.9	37.5	6.4		9.6
Outflow Geo Mean - Composites	ppb	43.9	8.6	18.7	38.4	6.9		8.0
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	100%	0%		34%

A condensed summary of the results of the analysis is presented in Tables 5.45 and 5.46, which is considered reflective of the long-term treatment performance of STA-5, 6 following full implementation of Alternative 3.

Table 5.45 Discharge Summary, STA-5 Alternative 3

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	175
Average Annual Outflow Volume	Ac-ft/yr	141,900
Average Annual Outflow TP Load	Kg/yr	2,591.8
Flow-weighted Mean TP Concentration	ppb	15
Geometric Mean TP Concentration, weekly composites	ppb	10**

**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

Table 5.46 Discharge Summary, STA-6 Alternative 3

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	67.7
Average Annual Outflow Volume	Ac-ft/yr	54,900
Average Annual Outflow TP Load	Kg/yr	997.0
Flow-weighted Mean TP Concentration	ppb	15
Geometric Mean TP Concentration, weekly composites	ppb	10**

**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

Tables 5.47 and 5.48 summarize the estimated total discharges from STA-5 Alternative 3 over the 50-year period 2007-2056, given that:

- STA-5, 6 will operate under Existing conditions over the period 2007-2014.
- STA-5, 6 will operate under Alternative 3 conditions over the period 2015-2056.

Table 5.47 STA-5 Alt. 3, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	To	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)
2007	2014	125,900	6,930.5	1,007,200	55,444
2015	2056	141,900	2,591.8	5,959,800	108,856
2007	**2056**	**139,300**	**3,286.0**	**6,967,000**	**164,300**
Flow-weighted mean TP Concentration in Discharges, ppb					**19**

Table 5.48 STA-6 Alt. 3, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	35,300	1,230.3	282,400	9,842
2015	2056	54,900	997.0	2,305,800	41,874
2007	**2056**	**51,800**	**1,034.3**	**2,588,200**	**51,716**
Flow-weighted mean TP Concentration in Discharges, ppb					**16**

5.6.4 Opinion of Probable Capital Cost

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 3 for STA-5, 6:

<u>STA-5:</u>

- Construction of approximately 2.0 miles of interior levee, subdividing fully extended Cells 1A and 2A into Cells 1AW and 1AE, and Cells 2AW and 2AE, respectively.
- Construction of approximately 2.0 miles of a new levee on the west bank of L-2 Canal to allow for elevated stages in the L-2 Canal.
- Construction of additional water control structures to convey water through the levee dividing AW Cells from AE Cells. These structures are assumed to be equivalent in number and character to STA-3/4 Structures G-375 (four 10’x8’ gated RCB’s with telemetric control).
- Addition of gates to the Structures G-343 (8 total)
- Two pump stations generally situated in the L-2 Canal, one serving the L-2 Canal, and one serving the Deer Fence / S&M Canal basins. These pumping stations are assumed to provide adequate capacity for accommodation of the Standard Project Flood (SPF) inflows (see the flow frequency analysis at the end of this Part 5).
- Extension of an overhead power distribution line on both north-south interior levees (total length of approximately 4 miles).

- Herbicide treatment of Cells 1AE, 2AE, and 2B for removal of emergent macrophyte vegetation to permit development of SAV.

STA-6:

- STA-6 Alternative 3 is identical to Alternative 1 with the exception of the addition of an operable control structure to regulate flows into Cell 3.

An opinion of the probable capital cost for STA-5, 6 in Alternative 3 are presented in Tables 5.49 and 5.50.

Table 5.49 Opinion of Probable Capital Cost, STA-5 Alternative 3

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Interior Levees, 7' height (Excludes Blasting Costs)	2.0	Mi.	$390,000	$780,000	Unit cost from Evaluation Methodology
2	New AW/AE Water Control Structures (10'x8', Gated)	4	Ea.	$200,000	$800,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
3	New Gates for Exist. G-343 Structures	8	Ea.	$45,000	$360,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
4	Water Control Structure Electrical (w/Telemetry) for N-S Interior Levees	12	Ea.	$43,000	$516,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
5	Stilling Wells (Includes Electrical and Telemetry) at N-S Interior Levees	6	Ea.	$9,000	$54,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
6	Electrical Power Distribution for N-S Interior Levees	4.0	Mi.	$80,000	$320,000	Unit cost from Evaluation Methodology
7	L-2 Pumping Station, SPF	1800	cfs	$7,500	$13,500,000	Unit cost from Evaluation Methodology
8	Deer Fence and S&M Pumping Station, SPF	970	cfs	$7,500	$7,275,000	Unit cost from Evaluation Methodology
9	New levee, west of L-2, 9' height	2.0	Mi.	$562,000	$1,124,000	Unit cost from Evaluation Methodology
10	Eradication of Existing Vegetation	1820	ac	$200	$364,000	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$25,093,000**	**25,100,000**
Planning, Engineering & Design		10 %			$2,509,300	**2,500,000**
Program & Construction Management		10 %			$2,509,300	**2,500,000**
Total Estimated Cost, Without Contingency					**$30,111,600**	**30,100,000**
Contingency		30 %			$9,033,480	**9,100,000**
Land Acquisition, West of L-2		Job	Lump		$642,000	**600,000**
TOTAL ESTIMATED CAPITAL COST					**$39,787,080**	**39,800,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

Table 5.50 Opinion of Probable Capital Cost, STA-6 Alternative 3

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee, 7' height (Excludes Blasting Costs)	0.8	Mi.	$390,000	$312,000	Unit cost from Evaluation Methodology
2	New Water Control Structures (10'x8', Gated)	3	Ea.	$200,000	$600,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
3	Water Control Structure Electrical (Includes Telemetry)	3	Ea.	$43,000	$129,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
4	Stilling Wells (Includes Electrical and Telemetry)	3	Ea.	$9,000	$27,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
5	Electrical Power Distribution	0.8	Mi.	$80,000	$64,000	Unit cost from Evaluation Methodology
6	Pumping Station, Cells 5A-5B	4	cfs	$7,600	$30,400	Unit cost from Evaluation Methodology
7	Pumping Station, Cells 2-4	11	cfs	$7,600	$83,600	Unit cost from Evaluation Methodology
8	Eradication of Existing Vegetation	1222	ac	$200	$244,400	Unit cost from 02/2002 STSOC for SAV/LR
Subtotal, Estimated Construction Costs					**$1,490,400**	**1,490,000**
Planning, Engineering & Design			10 %		$149,040	**150,000**
Program & Construction Management			10 %		$149,040	**150,000**
Total Estimated Cost, Without Contingency					**$1,788,480**	**1,790,000**
Contingency			30 %		$536,544	**540,000**
TOTAL ESTIMATED CAPITAL COST					**$2,325,024**	**2,330,000**

5.6.5 Opinion of Probable Annual Costs for Operation & Maintenance

The following is a summary listing of the anticipated incremental operation and maintenance requirements for Alternative 3 for STA-5, 6:

STA-5:

- Maintenance of approximately 2.0 miles of interior levee and 2.0 miles of west L-2 levee
- Operation and maintenance of the additional water control structures at both north-south interior levees.
- Operation and maintenance of the 2 inflow pump stations. The pumps are assumed to be driven by diesel engines.

- Additional herbicide treatment of Cells 1AE, 2AE, and 2B for control of invasive species and emergent macrophyte vegetation. This item includes both:
  - Annual costs to spray for invasive species.
  - Additional costs for post-drought eradication of undesirable species.

STA-6:

- STA-6 Alternative 3 is identical to Alternative 1 with the exception of the additional operation and maintenance of the new Cell 3 inflow control structure.

The February 22, 2002 Draft *Supplemental Technology Standard of Comparison (STSOC) Analysis for Submerged Aquatic Macrophyte/Limerock Technology*, D.B Environmental, presents an estimated cost of $25/acre/year for regular herbicide treatment for control of invasive species, and an additional $10/acre/year for post-drought eradication spraying. Given the inclusion of the available gradient in STA-5 and inclusion of forward-pumping stations in STA-6 for maintenance of stages in the SAV cells, the opinion of probable incremental operation and maintenance cost includes a substantially reduced allowance of $10/acre/year for both those items.

An opinion of the probable incremental operation and maintenance cost for Alternative 3 is presented in Tables 5.51 and 5.52.

Table 5.51 Opinion of Probable Incremental O&M Cost, STA-5 Alternative 3

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Levees	4.0	Mi.	$1,530	$6,120	Unit cost from Evaluation Methodology
2	New Water Control Structures (4 new + G-343 gate maint., 8*1/2)	8	Ea.	$12,000	$96,000	Unit cost from Evaluation Methodology
3	Mech. Maintenance, Pump Stations, per unit	6	Ea.	$23,000	$138,000	Unit cost from Evaluation Methodology
4	Fuel Consumption, Pump Stations	151,816	ac-ft	$0.50	$75,908	Unit cost from Evaluation Methodology
5	Lead Operator (New Stations)	1	Ea.	$60,000	$60,000	Unit cost from Evaluation Methodology
6	Engine Operator / Maintenance Mechanic (3 per station)	6	Ea.	$50,000	$300,000	Unit cost from Evaluation Methodology
7	Building Maintenance	2	Ea.	$12,000	$24,000	Unit cost from Evaluation Methodology
8	Incremental Cost forAnnual Vegetation Control, SAV Cells	2,420	ac	$10	$24,200	
9	Base Vegetation Control	730	ac	$22	$16,060	Unit cost from Evaluation Methodology, for added acreage
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$740,288**	
Contingency		30 %			$222,086	
TOTAL INCREMENTAL O&M COST					**$962,374**	**$960,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

Table 5.52 Opinion of Probable Incremental O&M Cost, STA-6 Alternative 3

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Internal Levee	0.8	Mi.	$1,530	$1,224	Unit cost from Evaluation Methodology
2	New Water Control Structures	3	Ea.	$12,000	$36,000	Unit cost from Evaluation Methodology
3	Mech. Maintenance, Pumping Station	2	Ea.	$10,000	$20,000	Unit cost from Evaluation Methodology
4	Power Consumption, Pumping Station, Cells 5A-5B	4	cfs	$300	$1,200	See text for basis of estimated unit cost
5	Power Consumption, Pumping Station, Cells 2-4	11	cfs	$300	$3,300	See text for basis of estimated unit cost
6	Incremental Cost forAnnual Vegetation Control	1222	ac	$10	$12,220	
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$73,944**	
Contingency		30 %			$22,183	
TOTAL INCREMENTAL O&M COST					**$96,127**	**$95,000**

5.6.6 Total Present Worth

The total present costs of STA-5, 6 for Alternative 3 is presented in Tables 5.53 and 5.54 and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation factor of 3%.

Table 5.53 Total Present Worth, STA-5 Alternative 3

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present**
Year	**Land Acq.**	**PED**	**P&CM**	**Const.**	**Total**	**Worth**
2011	$782,864	$3,261,933			$4,044,797	$2,969,606
2012			$1,679,895	$22,980,970	$24,660,866	$17,020,444
2013			$1,730,292	$23,670,399	$25,400,692	$16,480,430
Total Capital Cost					$50,061,557	$36,470,479
Incremental Costs for Operation and Maintenance						**Present**
From	**To**			**Total O&M Cost**		**Worth**
2015	2056				$115,635,676	$14,129,579
Total Present Worth of Alternative						**$50,600,058**

Table 5.54 Total Present Worth, STA-6 Alternative 3

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
		Capital Costs				**Present**
Year		**PED**	**P&CM**	**Const.**	**Total**	**Worth**
2012		$201,587	$100,794	$1,364,075	$1,666,456	$1,150,155
2013			$103,818	$1,404,997	$1,508,815	$978,947
Total Capital Cost					$3,175,271	$2,129,102
Incremental Costs for Operation and Maintenance						**Present**
From	**To**			**Total O&M Cost**		**Worth**
2015	2056				11,443,114	$1,398,240
Total Present Worth of Alternative						**$3,527,341**

5.7 STA-5, 6 Alternative No. 4

This alternative is a potential modification of the original plans for C-139 basin flows; there are presently no plans in CERP for C-139 flows to be routed through Compartment C. Under Alternative No. 4, flows that normally go to STA-5, 6 as in Alternative No. 1, would first be routed through Compartment C. Outflows from Compartment C are split into STA-5, 6 inflows with the same proportion as presented in Baseline 2015-2056 case. In addition, as in Alternative 3, some of Cell 3 flows of STA-6 are redistributed to the other STA-6 cells. In essence, Alternative 4 is similar to Alternative 1 with the exception of flows being routed through Compartment C first; this redirection of flows and added modifications reduces the uncertainty of applicability of SFWMM-generated inflows to STA-5.

5.7.1 Influence of EAA Storage Reservoir Phase 1 and 2 Project

For Alternative 4, it is assumed that all runoff from the C-139 Basin and the C-139 Annex are routed to Compartment C of the EAA Storage Reservoirs Project, Phase 1 and 2 in addition to the presently scheduled inflows (regulatory releases) from Lake Okeechobee. Outflows from the reservoir would then be distributed to STA-5 and STA-6, in proportion to their estimated treatment capacity.

For this analysis, the physical configuration of the reservoir is unchanged from that reflected in the SFWMM run for future conditions. As stated earlier, the area of Compartment C, initially created by the 2-mile by 2-mile grid system in the SFWMM is 12,800 acres was used in this study; a memo (Pro ECP 15, by SFWMD HSM WSD dated April 15, 2002) stated Compartment C as 9,000 acres. Since inflows for both STA-5, 6 route through Compartment C, and the anticipated effect for reservoir outflow concentration is approx. 2 ppb higher, and once routed through both STAs is anticipated to be negligible.

The average land surface elevation is set at 13.86 ft. NGVD. Daily rainfall and evapotranspiration estimates were taken from the data set for STA-6. Seepage losses from the reservoir (unrecovered) were assigned at 0.1 m/yr/m depth, consistent with the 2050wPROJ simulation.

Total daily discharges from the reservoir were assigned at the greater of the following:

- Reservoir releases established at the daily values taken from the 2050wPROJ simulation for environmental water supply.
- A stage-driven discharge rating, in which the desired total volume of release on any given day is established on the basis of the previous day stage in the reservoir. The discharge rating employed in this analysis is in the form:

  $Q=2.24*(D-1.0)^{4.5}$, where

  Q= daily discharge volume in acre-feet
  D= mean depth in the reservoir (e.g., stage minus mean ground surface elevation), in feet.

The analysis was initiated with an assigned stage of 14.86 ft. NGVD (1.0 ft. above the mean ground surface elevation). As indicated above, no discharge was assumed from the reservoir if the previous day's stage was equal to or less than 14.86 ft. NGVD, unless the SFWMM simulation indicated the need for environmental water supply. The following stage and depth data resulted from the analysis:

Maximum stage = 20.84 ft. NGVD (mean depth of 6.98 ft., or 2.13m).
Average stage = 17.60 ft. NGVD (mean depth of 3.74 ft., or 1.14 m)
Minimum stage = 13.88 ft. NGVD (mean depth of 0.02 ft.)

The wet period fraction (e.g., proportion of time for which the water surface is above the mean ground surface elevation) for this analysis is 1.00.

Figure 5.8 presents a graphic comparison of the monthly inflows to and discharges from Compartment C, developed as described above. That figure also presents the total releases for environmental water supply taken from the 2050wPROJ simulation for Compartment C, and demonstrates that those releases can be met with the reservoir characteristics and operation defined above.

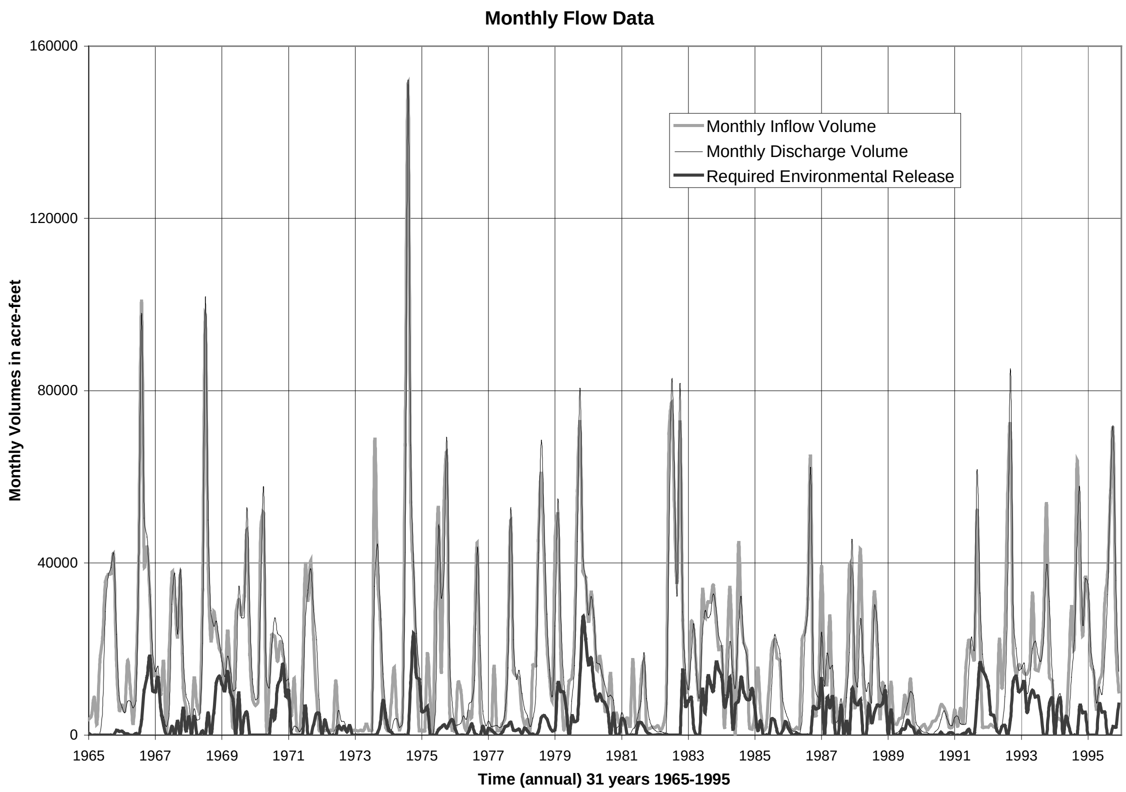


Figure 5.8 Monthly Inflows to and Discharges from Compartment C

Figure 5.9 presents a summary of the maximum and minimum monthly depths in the reservoir resulting from the analysis.

It is noted that the above assumed operating "rule" for the reservoir is simplistic in nature; any number of operating rules could be postulated and tested. The purpose of this analysis was primarily to assess the impact of routing all defined inflows to STA-5 and STA-6 through Compartment C on total phosphorus loads and concentrations entering the two treatment areas.

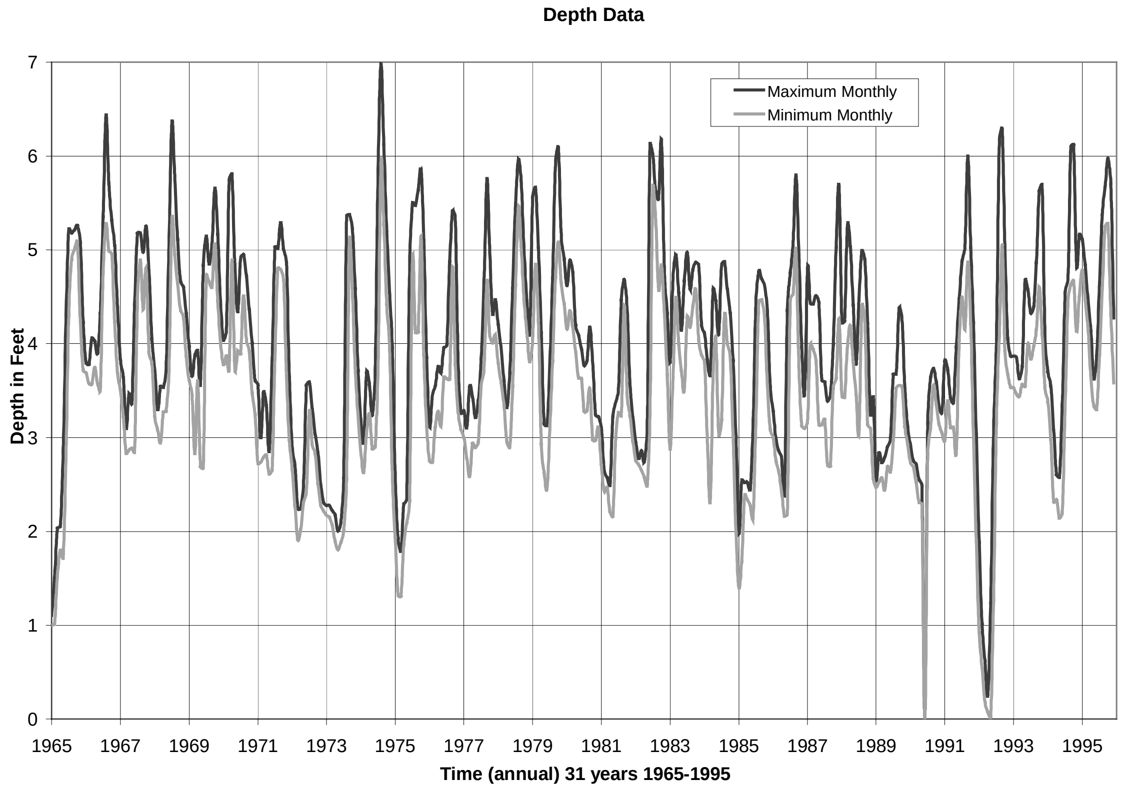


Figure 5.9 Maximum and Minimum Monthly Depths in Compartment C

TP Loads: As noted above, daily estimates of TP inflow loads to the various reservoir compartments (other than overflows from one compartment to another) were taken from the District-furnished Excel files. For this analysis, it was necessary to estimate TP concentrations in the reservoir in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir. Those estimates were developed on the assumption that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoirs was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention*

Basins, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates in the reservoir were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. A Summary of the long-term estimate of TP reduction in the Compartment C is presented in Table 5.55.

The estimated performance the EAA Storage Reservoir compartments in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 5.55 Estimated Long-Term Average Outflow Concentration, Compartment C

Mean Depth in Reservoir (m)	(For wet period fraction)					**1.141**
Approx. Basin Area (acres)						**12,800**
Approx. Basin Area (sq.m.)						**51,799,936**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)					
Input Parameters			**Estimated TP Removal**			
Average Inlet Concentration	mg/l	0.1467	q	4.960		
Average Annual Inflow Volume	ac-ft	211,681	K	0.046		
Average Annual Inflow Volume	cu.m.	261,105,717	P	156	ppb	
Average Annual Rainfall	m	1.321	N	1.657		
Average Annual Evapotranspiration	m	1.366		2.762		
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.026	R	0.468		
Infiltration from Groundwater	m/yr	0.000	Pout	82.9	ppb	
Water Balance Adjustment & Exfiltration	m/yr	0.1046	Pout	0.0829	mg/l	
Change in Storage	m./yr.	0.036	REF:	*Phosphorus Removal by Urban Runoff Detention Basins;* Lake and Reservoir Management, Volume 3; North American Lake Management Society; 1987		
Ave. TP Conc. In Seepage Inflows	mg/l	0.000				
Wet Period Fraction		1.000				
SUMMARY OF RESULTS						
Reservoir Area	acres	12,800				
Ave. Annual Outflow Volume	cu.m.	251,491,649				
Ave. Annual Outflow Volume	ac-ft	203,886		Surface Discharges Only		
Mean TP Conc. In Outflows	mg/l	0.0829				

The daily simulation of Compartment C is contained in a furnished Excel file "Compartment C Alt4.xls".

5.7.2 STA-5, 6 Input Data Summary

The following paragraphs summarize basic data employed in the analysis of Alternative 4 Conditions for STA-5, 6. Daily inflow rates, TP concentrations, rainfall and evapotranspiration employed in the DMSTA analysis of that condition are included in Excel files "5ALT4_Data.xls" and "6ALT4_Data.xls".

Inflow Volumes and TP Loads: A summary of the estimated average annual inflow volumes and loads to STA-5, 6 under Alternative 4 (2015-2056) is presented in Table 5.56.

Table 5.56 Estimated Inflows, 1965-1995, STA-5, 6 Alt. 4 Analysis

Inflow Source and Description	Average Annual Inflow		Flow-Weighted
	Volume	TP Load	Mean TP Conc.
	(ac-ft)	(1,000 kg)	(ppb)
Comp C Surface Flows to STA 5	146,385	15.17	84
Comp C Surface Flows to STA 6	59,503	6.17	84
Total Average Annual Inflows	**205,888**	**21.33**	**84**

5.7.3 Results of DMSTA Analysis for Alternative 4 2015-2056

Detailed listings of input variables employed in the analysis of the Baseline 2015-2056 Condition for STA-5, 6, together with detailed listings of computed output variables resulting from those analyses, are presented in Tables 5.57 and 5.58 (which consist of screen information taken directly from the DMSTA output files).

Table 5.57 Results of DMSTA Analysis, STA-5 Alternative 4

Case Description: Cells 1A & 2A--Emergent & Cells 1B & 2B--SAV_C4
Filename: 5ALT4_Data.xls

Input Variable	Units	Value
Design Case Name	-	Alt4
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	13.8
Flow-Wtd Conc - Without Bypass	ppb	13.8
Geometric Mean Conc	ppb	8.2
95th Percentile Conc	ppb	17.7
Freq Cell Outflow > 10 ppb	%	39%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B		
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4		
Inflow Fraction	-	0.5	0	0.5	0		
Downstream Cell Number	-	2	0	4	0		
Surface Area	km2	3.379	4.937	3.379	4.937		
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	60	40	60		
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78		
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0033		
Outflow Seepage Control Elev	cm	-46	-38	-46	-38		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.45	12.19	18.26	24.03			24.03
Run Date	-	06/13/02	06/13/02	06/13/02	06/13/02			06/13/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1A	1B	2A	2B			Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow			-
Surface Area	km2	3.379	4.937	3.379	4.937			16.6
Mean Water Load	cm/d	7.2	4.9	7.2	4.9			2.9
Max Water Load	cm/d	82.4	56.1	82.4	56.1			33.5
Inflow Volume	hm3/yr	89.1	87.8	89.1	87.8			178.2
Inflow Load	kg/yr	7490.4	5109.9	7490.4	5074.3			14980.8
Inflow Conc	ppb	84.0	58.2	84.0	57.8			84.0
Treated Outflow Volume	hm3/yr	87.8	85.8	87.8	84.2			170.0
Treated Outflow Load	kg/yr	5109.9	1185.7	5074.3	1168.5			2354.2
Treated FWM Outflow Conc	ppb	58.2	13.8	57.8	13.9			13.8
Total FWM Outflow Conc	ppb	58.2	13.8	57.8	13.9			13.8
Surface Outflow Load Reduc	%	31.8%	76.8%	32.3%	77.0%			84.3%
Outflow Geometric Mean - Daily	ppb	58.3	8.4	58.1	8.5			8.3
Outflow Geo Mean - Composites	ppb	57.8	8.2	57.6	8.3			8.2
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	0%			38%

Table 5.58 Results of DMSTA Analysis, STA-6 Alternative 4

Input Variable	Units	Value
Design Case Name	-	Alt4
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Cells 2,3 & 5a--Emergent and Cells 4 & 5b--SAV_C4 **Filename:** 6ALT4_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	13.9
Flow-Wtd Conc - Without Bypass	ppb	13.9
Geometric Mean Conc	ppb	9.8
95th Percentile Conc	ppb	18.3
Freq Cell Outflow > 10 ppb	%	15%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	2	4	3	5a	5b	
Vegetation Type	------->	EMERG	SAV_C4	EMERG	EMERG	SAV_C4	
Inflow Fraction	-	0.6	0	0.11	0.29	0	
Downstream Cell Number	-	2	0	0	5	0	
Surface Area	km2	2.242	3.363	0.991	1.056	1.582	
Mean Width of Flow Path	km	2.34	2.32	0.61	1.12	1.48	
Number of Tanks in Series	-	3	3	3	3	3	
Outflow Control Depth	cm	40	60	40	40	60	
Outflow Coefficient - Exponent	-	1.67	1.67	3.08	3.56	5.07	
Outflow Coefficient - Intercept	-	0.18	0.2	0.63	0.29	0.24	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0.0059	0.0017	0	0	0	
Outflow Seepage Control Elev	cm	-46	-46	0	0	0	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0.5	0.5	0	0	0	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*15.66*	*80.10*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	8.90	14.74	20.61	26.78	32.55		32.55
Run Date	-	06/13/02	06/13/02	06/13/02	06/13/02	06/13/02		06/13/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95		12/31/95
Output Duration	days	11322	11322	11322	11322	11322		11322
Cell Label		2	4	3	5a	5b		Total Outflow
Downstream Cell Label		4	Outflow	Outflow	5b	Outflow		-
Surface Area	km2	2.242	3.363	0.991	1.056	1.582		9.2
Mean Water Load	cm/d	5.4	3.4	2.2	5.5	3.7		2.2
Max Water Load	cm/d	61.4	39.3	25.5	63.0	42.0		24.9
Inflow Volume	hm3/yr	44.1	41.7	8.1	21.3	21.3		73.5
Inflow Load	kg/yr	3704.2	2071.7	679.1	1790.4	1064.4		6173.7
Inflow Conc	ppb	84.0	49.7	84.0	84.0	50.1		84.0
Treated Outflow Volume	hm3/yr	41.7	40.4	8.0	21.3	21.2		69.7
Treated Outflow Load	kg/yr	2071.7	453.8	275.5	1064.4	240.8		970.1
Treated FWM Outflow Conc	ppb	49.7	11.2	34.3	50.1	11.4		13.9
Total FWM Outflow Conc	ppb	49.7	11.2	34.3	50.1	11.4		13.9
Surface Outflow Load Reduc	%	44.1%	78.1%	59.4%	40.5%	77.4%		84.3%
Outflow Geometric Mean - Daily	ppb	49.5	6.9	32.9	48.4	6.0		12.1
Outflow Geo Mean - Composites	ppb	49.3	6.7	32.2	48.5	6.3		9.8
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	100%	0%		47%

A condensed summary of the results of the analysis is presented in Tables 5.59 and 5.60, which are considered reflective of the long-term treatment performance of STA-5, 6 following full implementation of Alternative 4.

Table 5.59 Discharge Summary, STA-5 Alternative 4

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	170.0
Average Annual Outflow Volume	Ac-ft/yr	137,800
Average Annual Outflow TP Load	Kg/yr	2388.3*
Flow-weighted Mean TP Concentration	ppb	14*
Geometric Mean TP Concentration, weekly composites	ppb	10**

*Increased from computed value to reflect lower limit of calibration range.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

Table 5.60 Discharge Summary, STA-6 Alternative 4

Parameter	Units	Value
Average Annual Outflow Volume	Hm^3/yr	69.7
Average Annual Outflow Volume	Ac-ft/yr	56,500
Average Annual Outflow TP Load	Kg/yr	977.1*
Flow-weighted Mean TP Concentration	ppb	14*
Geometric Mean TP Concentration, weekly composites	ppb	10

* Increased from computed value to reflect lower limit of calibration range.

Tables 5.61 and 5.62 summarize the estimated total discharges from STA-5, 6, Alternative 4 over the 50-year period 2007-2056, given that:

- STA-5, 6 will operate under Existing conditions over the period 2007-2014.
- STA-5, 6 will operate under Alternative 4 conditions over the period 2015-2056.

Table 5.61 STA-5 Alt. 4, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	125,900	6,930.5	1,007,200	55,444
2015	2056	137,800	2,388.3	5,787,600	100,309
2007	**2056**	**135,900**	**3,115.1**	**6,794,800**	**155,753**
Flow-weighted mean TP Concentration in Discharges, ppb					**19**

Table 5.62 STA-6 Alt. 4, Total 50-Year Discharges

Period		Average Annual Discharge		Total Discharge for Period	
From	**To**	**Volume (ac-ft)**	**TP Load (kg)**	**Volume (ac-ft)**	**TP Load (kg)**
2007	2014	35,300	1,230.3	282,400	9,842
2015	2056	56,500	977.1	2,373,000	41,038
2007	**2056**	**53,100**	**1,017.6**	**2,655,400**	**50,880**
Flow-weighted mean TP Concentration in Discharges, ppb					**16**

5.7.3 Opinion of Probable Capital Cost

The following is a summary listing of the anticipated physical works necessary for implementation of Alternative 4 for STA-5 (STA-6 costs are identical to Alternative 3; the additional control structure in Cell 3 though not required is provided for additional flexibility):

- Construction of approximately 2.0 miles of a new levee on the west bank of L-2 Canal to allow for elevated stages in the L-2 Canal.
- Addition of gates to the Structures G-343 (8 total)
- Two pump stations generally situated in the L-2 Canal to lift waters into the Reservoir, one serving the L-2 Canal, and one serving the Deer Fence / S&M Canal basins. These pumping stations are assumed to provide adequate capacity for accommodation of the Standard Project Flood (SPF) inflows (see the flow frequency analysis at the end of this Part 5).

- Extension of an overhead power distribution line on both north-south interior levees (total length of approximately 2 miles).
- Herbicide treatment of Cells 1AE, 2AE, and 2B for removal of emergent macrophyte vegetation to permit development of SAV.

An opinion of the probable capital cost for Alternative 4 is presented in Table 5.63.

Table 5.63 Opinion of Probable Capital Cost, STA-5 Alternative 4

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	New Gates for Exist. G-343 Structures	8	Ea.	$45,000	$360,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
2	Water Control Structure Electrical (w/Telemetry) for N-S Interior Levees	8	Ea.	$43,000	$344,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
3	Stilling Wells (Includes Electrical and Telemetry) at N-S Interior Levees	4	Ea.	$9,000	$36,000	Unit cost from June 2001 Estimate for STA-3/4, Esc.
4	Electrical Power Distribution for N-S Interior Levees	2.0	Mi.	$80,000	$160,000	Unit cost from Evaluation Methodology
5	L-2 Pumping Station, SPF	1800	cfs	$7,500	$13,500,000	Unit cost from Evaluation Methodology
6	Deer Fence and S&M Pumping Station, SPF	970	cfs	$7,500	$7,275,000	Unit cost from Evaluation Methodology
7	New levee, west of L-2, 9' height	2.0	Mi.	$562,000	$1,124,000	Unit cost from Evaluation Methodology
8	Eradication of Existing Vegetation	1220	ac	$200	$244,000	Unit cost from 02/2002 STSOC for SAV/LR
9	New Water Control Structure, Res. To STA-5	2400	cfs	$687	$1,648,155	Unit Cost vs. Capacity Taken from Part 5, Sept. 1999 Alternatives Analysis for STA-3/4, escalated 10% to 2002
Subtotal, Estimated Construction Costs					**$24,691,155**	**24,700,000**
Planning, Engineering & Design		10 %			$2,469,115	**2,500,000**
Program & Construction Management		10 %			$2,469,115	**2,500,000**
Total Estimated Cost, Without Contingency					**$29,629,386**	**29,700,000**
Contingency		30 %			$8,888,816	**8,900,000**
Land Acquisition, West of L-2		Job	Lump		$642,000	**600,000**
TOTAL ESTIMATED CAPITAL COST					**$39,160,202**	**39,200,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

5.7.4 Opinion of Probable Annual Costs for Operation & Maintenance

The following is a summary listing of the anticipated <u>incremental</u> operation and maintenance requirements for Alternative 4 for STA-5 (STA-6 is identical to Alternative 3):

- Maintenance of approximately 2.0 miles of new levee west of L-2
- Maintenance of the gates added to Structures G-343
- Operation and maintenance of the 2 inflow pump stations.
- Additional herbicide treatment of Cells 1AE, 2AE and 2B for control of invasive species and emergent macrophyte vegetation. This item includes both:
  - Annual costs to spray for invasive species.
  - Additional costs for post-drought eradication of undesirable species.

The February 22, 2002 Draft *Supplemental Technology Standard of Comparison (STSOC) Analysis for Submerged Aquatic Macrophyte/Limerock Technology*, D.B Environmental, presents an estimated cost of $25/acre/year for regular herbicide treatment for control of invasive species, and an additional $10/acre/year for post-drought eradication spraying. Given the available gradient in STA-5 for maintenance of stages in the SAV cells, the opinion of probable incremental operation and maintenance cost includes a substantially reduced <u>allowance</u> of $10/acre/year for both those items.

An opinion of the probable <u>incremental</u> operation and maintenance cost for STA-5 Alternative 3 is presented in Table 5.64. Incremental O&M costs for STA-6 would b identical to those in Table 5.52.

Table 5.64 Opinion of Probable Incremental O&M Cost, STA-5 Alternative 4

Item No.	Description	Estimated Quantity	Unit	Estimated Unit Cost	Estimated Total Cost	Remarks
1	Incremental Cost forAnnual Vegetation Control	1220	ac	$10	$12,200	
2	Mech. Maintenance, Pump Stations, per unit	6	Ea.	$23,000	$138,000	Unit cost from Evaluation Methodology
3	Fuel Consumption, Pump Stations	203,888	ac-ft	$0.50	$101,944	Unit cost from Evaluation Methodology
4	Lead Operator (New Stations)	1	Ea.	$60,000	$60,000	Unit cost from Evaluation Methodology
5	Engine Operator / Maintenance Mechanic (3 per station)	6	Ea.	$50,000	$300,000	Unit cost from Evaluation Methodology
6	Building Maintenance	2	Ea.	$12,000	$24,000	Unit cost from Evaluation Methodology
7	Incremental Maintenance for added gates at G-343	8	Ea.	$6,000	$48,000	Unit cost from Evaluation Methodology
8	New Water Control Structure, Res. To STA-5	1	Ea.	$12,000	$12,000	Unit cost from Evaluation Methodology
Subtotal, Estimated Incremental Operation & Maintenance Costs					**$696,144**	
Contingency		30 %			$208,843	
TOTAL INCREMENTAL O&M COST					**$904,987**	**$905,000**

The opinions of probable incremental operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels, and do not include any allowance for cost escalation over the life of the project.

5.7.5 Total Present Worth

The total present of cost STA-5 for Alternative 4 is presented in Tables 5.65 and is computed as of December 31, 2002. (STA-6 is similar to Alternative 3.) It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation factor of 3%.

Table 5.65 Total Present Worth, STA-5 Alternative 4

Annual Discount Rate		**6.375%**		**Date of Pricing Data**		**12/31/02**
Present Cost as of		**12/31/2002**				
Annual Escalation Rate		**3.000%**		**Convenience Rate**		**3.277%**
Capital Costs						**Present Worth**
Year	**Land Acq.**	**PED**	**P&CM**	**Const.**	**Total**	
2011	$782,864	$3,261,933			$4,044,797	$2,969,606
2012			$1,679,895	$22,577,795	$24,257,691	$16,742,180
2013			$1,730,292	$23,255,129	$24,985,421	$16,210,995
Total Capital Cost					$49,243,112	$35,922,781
Incremental Costs for Operation and Maintenance						**Present Worth**
From	**To**			**Total O&M Cost**		
2015	2056				$109,010,715	$13,320,072
Total Present Worth of Alternative						**$49,242,853**

5.8 STA-5, 6 Summary of Evaluation Criteria Scoring

The following tables present summaries of the evaluation criteria scoring for the alternative water quality improvement strategies for STA-5, 6. The information presented therein will subsequently be employed by the District and others in further evaluation of the alternatives, and identification of that alternative or alternative(s) to be carried forward to the conceptual design phase.

Table 5.66 Summary Evaluation Criteria Scores, STA-5 Alternative 1

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	389	Table 5.19
		50-Year TP Load Disc. - Alternative 1	tonnes	196	Table 5.25
		Phosphorus Load Reduction	%	49.6	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	19	Table 5.23
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	12	Table 5.23
3	Implementation Schedule		years	12	2014 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$504,095	Table 5.31
	2	Total 50-Year TP Removal	kg	192,936	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$2.61	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

Table 5.67 Summary Evaluation Criteria Scores, STA-6 Alternative 1

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	101	Table 5.20
		50-Year TP Load Disc. - Alternative 1	tonnes	60	Table 5.26
		Phosphorus Load Reduction	%	40.4	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	17	Table 5.24
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10	Table 5.24
3	Implementation Schedule		years	12	2014 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$2,940,993	Table 5.32
	2	Total 50-Year TP Removal	kg	40,824	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$72.04	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

Table 5.68 Summary Evaluation Criteria Scores, STA-5 Alternative 2

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	389	Table 5.19
		50-Year TP Load Disc. - Alternative 2	tonnes	165	Table 5.37
		Phosphorus Load Reduction	%	57.7	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	19	Table 5.23
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	12	Table 5.23
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$676,753	Table 5.39
	2	Total 50-Year TP Removal	kg	224,126	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$3.02	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

Table 5.69 Summary Evaluation Criteria Scores, STA-6 Alternative 2

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	101	Table 5.20
		50-Year TP Load Disc. - Alternative 2	tonnes	56	Table 5.38
		Phosphorus Load Reduction	%	44.3	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	17	Table 5.24
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10	Table 5.24
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$3,432,455	Table 5.40
	2	Total 50-Year TP Removal	kg	44,696	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$76.80	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)

- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

Table 5.70 Summary Evaluation Criteria Scores, STA-5 Alternative 3

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	389	Table 5.19
		50-Year TP Load Disc. - Alternative 3	tonnes	164	Table 5.47
		Phosphorus Load Reduction	%	57.7	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	15	Table 5.45
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10**	Table 5.45
3	Implementation Schedule		years	12	2014 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-2	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$50,600,058	Table 5.53
	2	Total 50-Year TP Removal	kg	224,368	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$225.52	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

** Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

Table 5.71 Summary Evaluation Criteria Scores, STA-6 Alternative 3

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	101	Table 5.20
		50-Year TP Load Disc. - Alternative 3	tonnes	52	Table 5.48
		Phosphorus Load Reduction	%	48.8	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	15	Table 5.46
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10**	Table 5.46
3	Implementation Schedule		years	12	2014 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$3,527,341	Table 5.54
	2	Total 50-Year TP Removal	kg	49,228	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$71.65	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

** Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

Table 5.72 Summary Evaluation Criteria Scores, STA-5 Alternative 4

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	389	Table 5.19
		50-Year TP Load Disc. - Alternative 4	tonnes	156	Table 5.61
		Phosphorus Load Reduction	%	59.9	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	14*	Table 5.59
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10**	Table 5.59
3	Implementation Schedule		years	12	2014 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$49,242,853	Table 5.65
	2	Total 50-Year TP Removal	kg	232,915	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$211.42	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

* Computed F.W.M. Conc. Less than LSC assigned as 14 ppb.
** Computed Geo.Mean Conc. Less than LSC assigned as 10 ppb.

Table 5.73 Summary Evaluation Criteria Scores, STA-6 Alternative 4

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	101	Table 5.20
		50-Year TP Load Disc. - Alternative 4	tonnes	51	Table 5.62
		Phosphorus Load Reduction	%	49.6	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	14*	Table 5.60
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	10	Table 5.60
3	Implementation Schedule		years	12	2014 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	0	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$3,527,341	Table 5.54
	2	Total 50-Year TP Removal	kg	50,064	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$70.46	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

* Computed F.W.M. Conc. Less than LSC assigned as 14 ppb.

5.9 STA-5, 6 Sensitivity Analyses of Phosphorus Reduction Parameters

The effectiveness of phosphorus reduction in the alternatives considered are examined with respect to the change in the following three input parameters presented in the sensitivity analyses:

- Varying BMP Performance
- Different SAV Communities
- All Input Parameters
  - Uncertainty Analysis

The third analysis (all input parameters) also employs an uncertainty analysis. The information presented therein will assist the District in further analyses of the alternatives presented in the future evaluation of the parameters.

In addition, an analysis of the sensitivity of overall treatment performance to reduced inflow pumping station capacity (STA-5, Alternative 3) peak frequency of C-139 inflows into STA-5 and STA-6 is presented in Section 5.9.4.

5.9.1 Variation in BMP Performance

For STA-5, 6, the current level of 0% TP load reduction in C-139 basin runoff due to BMPs was varied to 25%. In addition, for STA-6, the current level of 50% TP load reduction in USSC basin runoff was varied to 25% and 75%. For Alternative 4 only, STA-5 inflows are affected by the BMP levels of the USSC basin. The TP inflows into STA 5, 6 were recalculated using these BMP levels. Tables 5.70 and 5.71 summarizes, for all alternatives, the outcome of the phosphorus reduction performance due to varying BMP performance.

Table 5.74 Variation in STA-5 BMP Performance

Condition	Location	TP Conc. For BMP Load Reduction in C-139 Basin of			
		0%		25%	
		F.W.	Geo.	F.W.	Geo.
Baseline,	STA-5 Inflows	178	--	134	--
Existing	STA-5 Outflows	45	32	36	25
Baseline,	STA-5 Inflows	178	--	134	--
Future	STA-5 Outflows	46	36	37	28
Alternative 1	STA-5 Inflows	178	--	134	--
(Post-CERP)	STA-5 Outflows	19	12	17	10
Alternative 2	STA-5 Inflows	178	--	134	--
(Pre-CERP)	STA-5 Outflows	20	10	17	10**
Alternative 3	STA-5 Inflows	179	--	134	--
(Post-CERP)	STA-5 Outflows	15	10**	14*	10**
Alternative 4#	STA-5 Inflows	84	--	71	--
(Post-CERP)	STA-5 Outflows	14*	10**	14*	10**

#also affected by inflows from USSC Basin
*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

In addition, in the case for which BMP loads for USSC Basin are increased to 25%, the inflow into STA-5 is 85 ppb, with F.W.M. and G.M. outflows at 14* and 10** ppb as well.

Table 5.75 Variation in STA-6 BMP Performance

Condition	Location	TP Conc. For BMP Load Reduction in USSC Basin of					
		25%		50%		75%#	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
Baseline,	STA-6 Inflows	128	--	87	--	42	--
Existing	STA-6 Outflows	33	27	28	20	20	13
Baseline,	STA-6 Inflows	84	--	76	--	66	--
Future	STA-6 Outflows	32	27	31	25	28	23
Alternative 1	STA-6 Inflows	84	--	76	--	66	--
(Post-CERP)	STA-6 Outflows	17	10	17	10	16	10**
Alternative 2	STA-6 Inflows	128	--	87	--	42	--
(Pre-CERP)	STA-6 Outflows	19	10	17	10**	14	10**
Alternative 3	STA-6 Inflows	77	--	69	--	61	--
(Post-CERP)	STA-6 Outflows	15	10**	15	10**	15	10**
Alternative 4	STA-6 Inflows	85	--	84	--	71	--
(Post-CERP)	STA-6 Outflows	14	10	14*	10	14*	10**

#also includes a 25% BMP Reduction of the C-139 Basin
*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

5.9.2 Variation in SAV Performance

The current vegetative community (SAV_C4) was changed to the vegetative community (SAV) to determine the effects of different vegetative communities on the phosphorus reduction parameters. Table 5.72 and 5.73 summarizes, for Alternatives #1 and #2, the outcome of the phosphorus reduction performance due to different SAV communities.

Table 5.76 Variation in STA-5 SAV Performance

Condition	Location	TP Conc. For Different SAV Communities			
		SAV_C4		NEWS	
		F.W.	Geo.	F.W.	Geo.
Baseline, Existing	STA-5 Inflows	178	--	178	--
	STA-5 Outflows	45	32	50	34
Baseline, Future	STA-5 Inflows	178	--	178	--
	STA-5 Outflows	46	36	50	38
Alternative 1 (Post-CERP)	STA-5 Inflows	178	--	178	--
	STA-5 Outflows	19	12	28	14
Alternative 2 (Pre-CERP)	STA-5 Inflows	178	--	178	--
	STA-5 Outflows	20	10	30	13
Alternative 3 (Post-CERP)	STA-5 Inflows	179	--	179	--
	STA-5 Outflows	15	10**	24	12
Alternative 4 (Post-CERP)	STA-5 Inflows	84	--	84	--
	STA-5 Outflows	14*	10**	21	12

*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

Table 5.77 Variation in STA-6 SAV Performance

Condition	Location	TP Conc. For Different SAV Communities			
		SAV_C4		NEWS	
		F.W.	Geo.	F.W.	Geo.
Alternative 1 (Post-CERP)	STA-6 Inflows	76	--	76	--
	STA-6 Outflows	17	10	24	14
Alternative 2 (Pre-CERP)	STA-6 Inflows	86	--	86	--
	STA-6 Outflows	17	10**	24	13
Alternative 3 (Post-CERP)	STA-6 Inflows	69	--	69	--
	STA-6 Outflows	15	10**	22	12
Alternative 4 (Post-CERP)	STA-6 Inflows	84	--	84	--
	STA-6 Outflows	14*	10	20	13

**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

As with the other STAs, the results show that the phosphorus reduction performance is fairly sensitive to the SAV community used.

5.9.3 All Input Variables (DMSTA Sensitivity Model)

The sensitivity of the phosphorus reduction performance to all input variables available in the DMSTA model was tested through its built-in Sensitivity Model which also includes an Uncertainty Analysis module. The Sensitivity Model assesses the average percent change in these four output parameters for each input changed:

- Treated Flow-weighted Mean Outflow Concentration
- Total Flow-weighted Mean Outflow Concentration
- Outflow Geometric Mean – Composite
- Total Outflow Load

A Sensitivity Scale Factor of 25% (i.e. 25% change in each input) was used in all runs. Both high and low results were tested; in other words, two runs were conducted for each input variable, one at 75% and the other at 125% of the original value of the input variable under consideration. With approximately 25 different input variables, multiplied by the number of cells in the STA, and the high and low end of results tested, the Sensitivity Analysis included a potential of 120 or more DMSTA runs for each case.

No change in output from each run for each case exceeded 25%. The biggest changes in the four output variables, consistently across each case, were caused by the following input variables:

- Inflow Fraction
- C0 = WC Conc at 0 g/m2 P Storage
- Zx = Depth Scale Factor
- K = Net Settling Rate at Steady State
- Surface Area

The DMSTA Model also includes an Uncertainty Analysis which lists the actual change of any one of the four above-listed output variables based on the "uncertainty" of the input variables. If one of the 23 variables (available in this analysis) under consideration is insensitive, then the range of values will not change significantly.

The DMSTA Uncertainty Analysis uses results from the above Sensitivity Model. The input into the model is the variable labeled "Error CV", which is the Standard Error divided by the Mean. The default input Error CV in the DMSTA model was utilized for the analyses. The outputs are the 10th, 50th, and 90th percentile estimate of the four listed output parameters.

Since the analysis of STA-5, 6 includes no bypass analysis, the resultant Total Flow-weighted Mean Outflow Concentration is the same as the resultant Treated Flow-weighted Mean Outflow Concentration. Outputs from the four DMSTA cases are shown in Tables 5.78 and 5.79.

Table 5.78 Uncertainty Analyses of All STA-5 Input Variables

Condition	Location	TP Conc. In DMSTA Sensitivity Analyses								
		10th Percentile Est.			50th Percentile Est.			90th Percentile Est.		
		F.W.	Geo.	Load	F.W.	Geo.	Load	F.W.	Geo.	Load
Baseline, Existing	STA-5 Outflows	35	25	5,459	45	32	6,930	54	39	8,402
Baseline, Future	STA-5 Outflows	36	28	6,267	46	36	7,934	55	44	9,601
Alternative 1 (Post-CERP)	STA-5 Outflows	15	10**	2,593	19	12	3,340	24	14	4,087
Alternative 2 (Pre-CERP)	STA-5 Outflows	15	10**	2,359	20	10	3,032	24	13	3,705
Alternative 3 (Post-CERP)	STA-5 Outflows	12	10**	2,448*	15	10**	2,592	18	10	3,137
Alternative 4 (Pre-CERP)	STA-5 Outflows	14*	10**	2,388*	14*	10**	2,388*	17	10	2,849

* Increased from computed value to reflect lower limit of calibration range.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

Table 5.79 Uncertainty Analyses of All STA-6 Input Variables

Condition	Location	TP Conc. In DMSTA Sensitivity Analyses								
		10th Percentile Est.			50th Percentile Est.			90th Percentile Est.		
		F.W.	Geo.	Load	F.W.	Geo.	Load	F.W.	Geo.	Load
Baseline, Existing	STA-6 Outflows	21	15	934	28	20	1,230	35	26	1,527
Baseline, Future	STA-6 Outflows	23	19	1,663	31	25	2,169	38	31	2,675
Alternative 1 (Post-CERP)	STA-6 Outflows	14*	10**	991*	17	10	1,197	21	12	1,474
Alternative 2 (Pre-CERP)	STA-6 Outflows	14*	10**	605*	17	10**	746	21	11	922
Alternative 3 (Post-CERP)	STA-6 Outflows	14*	10**	948*	15	10**	997	18	10	1,229
Alternative 4 (Pre-CERP)	STA-6 Outflows	14*	10**	977*	14*	10	977*	17	12	1,198

* Increased from computed value to reflect lower limit of calibration range.
**Computed Geo.Mean Conc. less than LSC assigned as 10 ppb.

The results show that there is a fairly wide range of uncertainty in phosphorus reduction performance, particularly in the baseline conditions.

5.9.4 Sensitivity to Reduced Pumping Station Capacities

An analysis of flood peak frequency for the C-139 Basin to determine pump sizing for Alternatives 3 and 4 was performed using a 31-year period of record from 1965 through 1995. Mean daily inflows to STA-5 and STA-6 from C-139 during this period were combined to produce the total daily discharge data for this analysis. The data was divided into 31 water years, with each water year beginning on 1 May of that calendar year and ending on 30 April of the next calendar year. The water year 1995 begins on 5/01/1995 and ends on 12/31/1995; this partial year was included in the analysis as it encompassed the normal wet season.

A summary of the peak annual mean daily discharge data used in this analysis is in Table 5.80.

The flood peak frequency analysis was performed using methodology presented in USGS Bulletin 17B and EM 1110-2-1415, *Hydrologic Frequency Analysis*. These references use the log-Pearson Type III distribution as the base method for analysis of annual series data using a weighted skew coefficient.

Table 5.80 Mean Daily Discharge Data of C-139 Basin

Water Year	**Annual Average Discharge (CFS)**	**Peak Daily Discharge (CFS)**	Water Year	**Annual Average Discharge (CFS)**	**Peak Daily Discharge (CFS)**
1965	328	1187	1981	83	971
1966	279	1050	1982	417	1584
1967	245	707	1983	188	932
1968	270	1048	1984	128	721
1969	368	1312	1985	127	552
1970	131	668	1986	202	1107
1971	200	887	1987	161	713
1972	34	576	1988	128	668
1973	205	1900	1989	61	513
1974	342	2096	1990	65	412
1975	324	1346	1991	127	1090
1976	136	1009	1992	205	1153
1977	172	1437	1993	185	1166
1978	337	1009	1994	326	956
1979	252	893	1995		1116
1980	71	435	**AVE.**	**203**	**1007**

The logarithm of the annual peak discharge was taken for each water year. The mean of these logarithms was calculated to be 2.9709. The standard deviation of these logarithms was calculated to be 0.17218, and the skew coefficient was calculated to be –0.20830. A generalized skew coefficient of –0.1 was read from Plate 1 of Bulletin 17B. The mean-square error of the calculated skew coefficient was taken from Table 1 of Bulletin 17B to be 0.183. The weighted skew was then calculated to be –0.1674; a skew of –0.2 was adopted for use in the analysis.

The normal standard deviate, K, for a 10% exceedance probability was read from Appendix 3 of 17B to be K=1.25824. For a 1% exceedance probability, K=2.17840. These values of K resulted in a "10-year" discharge of 1,540 cfs and a "100-year" discharge of 2,218 cfs. These flow values were then adjusted to account for expected probability by using an adjusted deviate value. Table F-7 in EM 1110-2-1415 gave K=1.333 for a 10% exceedance probability and K=2.503 for a 1% exceedance probability. The corresponding adjusted flow values are 1586 cfs and 2523 cfs, respectively.

The Standard Project Flood (SPF) discharge was calculated at 125% of the 100-year discharge, consistent with SPF definition adopted for the Central & Southern Florida Project by the U.S. Army Corps of Engineers. Without an adjustment for expected probability, this value is 2,772 cfs. With an adjustment made for expected probability, this value is 3,153 cfs. Table 5.81 below summarizes estimated flood peak frequencies resulting from this analysis.

Table 5.81 Mean Daily Discharge for C-139 Basin

	WITHOUT Expected Probability Adjustment	**WITH Expected Probability Adjustment**
10-year Mean Daily Discharge	1540 cfs	1586 cfs
100-year Mean Daily Discharge	2218 cfs	2523 cfs
Standard Project Flood Mean Daily Discharge	2772 cfs	3153 cfs

The above discharges were developed using mean daily discharge data. No information on peak instantaneous discharges is available. Peak discharges corresponding to any given return period can be expected to exceed the above values. For this analysis, a ratio between peak instantaneous and mean daily discharge of 1.20 was assumed (e.g., the above values are increased 20% for computation of nominal hydraulic capacity).

If the pump was sized to handle 10-year Mean Daily Discharges (1,540 cfs), STA-5 in Alternative 3 would have an average annual bypass load and flow-weighted mean concentration of 1,394 ac-ft and 195 ppb, respectively. Adding this bypass to the adjusted STA-5 Alternative 3 outflow load and flow-weighted mean concentration of 140,506 ac-ft (i.e., 141,900 ac-ft – 1,394 ac-ft) and 15 ppb, respectively, the total outflow flow-weighted mean concentration from STA-5 in Alternative 3 would be 17 ppb.

For this decrease in treatment performance, the direct capital cost savings in downsizing the pumps to handle 10-year instead of SPF flows is $9,240,000. After addition of engineering design, contingencies, and other costs, the total savings are increased to $14,391,000.

Table of Contents

List of Tables

List of Figures

6. INTEGRATED TREATMENT AREAS

This Part 6 presents the results of an evaluation of a more global alternative in which STA-2, STA-3/4, STA-5 and STA-6, as well as the EAA Reservoirs are treated as an integrated whole. The purpose in development of this Integrated Alternative is to assess the extent to which adjustment of the EAA Storage Reservoirs Project as modeled in the SFWMM 2050wPROJ simulation used for the Basin-Specific Feasibility Studies might effectively contribute to an ability to meet the long-term water quality improvement goals of the Everglades Forever Act, while not sacrificing the hydrologic function of the EAA Reservoirs.

> The Integrated Alternative presented in this Part 6 cannot be considered as an optimized solution. The interrelationships of the various stormwater treatment areas and the potential EAA Storage Reservoirs are highly complex. A wide variety of alternatives could, and should, be postulated and considered in detail. Time and budget restraints inherent in the scope of Contract C-E023 permitted the development of but one of the many possible adjustments which could be made to the 2050wPROJ simulation in the interest of water quality improvement, while maintaining the hydrologic function of the Reservoir(s).

It is anticipated that the Project Development Team (PDT) for the EAA Storage Reservoirs Project, Phase 1 will consider this and other possible adjustments as it develops and evaluates alternatives for that critical CERP component. Based on the results of the analyses presented in this Part 6, it is recommended that the PDT consider the following basic suggestions for enhanced performance of the project in contributing to water quality improvement goals for discharges to the Everglades Protection Area:

- Maximize the proportion of time that storage elevations in the reservoir(s) are above ground (e.g., minimize the frequency and duration of dryout).
- Recognize that water quality improvement performance can be expected to increase with increased depth, at least within the range of possible depths of the EAA Storage Reservoirs(s).
- Note that the total phosphorus loads introduced to the downstream stormwater treatment areas are reduced as the proportion of the total inflow which first pass through the reservoir(s) is increased.

- Understand that, as the surface area of the reservoir increases, not only do evaporation losses increase, but also the atmospheric input of phosphorus and other pollutants to the reservoir and downstream system increases.

Incorporation of the above suggestions into the PDT's alternatives can be expected to favor the development of deeper reservoirs with less surface area, to which the maximum proportion of total basin inflows are directed, and in which strict partitioning of inflows by source and destination is reduced.

The analyses conducted for the single iteration of the Integrated Alternative presented herein employ certain strategies for incorporation of the above suggestions. Those strategies include:

- In lieu of spatial partitioning of storage volumes by source and demand, consider the definition of a minimum storage volume or elevation below which only defined irrigation and environmental water supply releases are made. That elevation or volume can be established to satisfy those demands either for the full period of simulation (as was done herein), or on the basis of a defined drought recurrence interval. Incorporation of this strategy can be expected to lead to a reduced total length of impoundment levees, as well as a reduced number and total installed hydraulic capacity of pumping stations and other water control structures.
- Maximize the use of the water control infrastructure now existing or under construction for the introduction of basin inflows to the reservoir(s). As an example, consider the use of Pumping Stations G-370 and G-372 as inflow pump stations to the reservoir(s), with all STA-3/4 inflows first passing through the reservoir. As compared to the 2050wPROJ simulation, that approach can be expected to minimize the pollutant loads discharged to STA-3/4, while at the same time reducing the extent to which potentially duplicative hydraulic capacity might be installed.
- Direct discharges from the reservoirs to the various stormwater treatment areas in proportion to their capacity for further improving the quality of those discharges (e.g., attempt to "balance" reservoir discharges with downstream treatment capacity).

➢ Consider expanding the number of sources from which runoff and other discharges are introduced to the reservoir(s). Examples might include the C-139 Basin and the C-139 Annex.

6.1. Basic Information

Parts 4 and 5, respectively, of this document present information based on a SFWMM regional simulation (2050wPROJ) which was performed specifically for the Basin-specific Feasibility Studies. The 2050wPROJ simulation, which included both Phase 1 and Phase 2 of the EAA Storage Reservoirs Project, represents one possible scenario of the combined EAA reservoirs and STAs. It should be noted that the 2050wPROJ simulation included a total of approximately 360,000 acre-feet of storage in the Phase 1 and Phase 2 reservoirs, versus the 240,000 acre-feet of storage currently contemplated in the Phase 1 reservoirs. The 2050wPROJ simulation included the following approximate surface areas of the Phase 1 and Phase 2 reservoir compartments:

- Compartment A1: 20,000 acres
- Compartment A2: 21,500 acres
- Compartment B: 9,500 acres
- Compartment C: 9,000 acres

The total surface area reflected in the 2050wPROJ simulation was approximately 60,000 acres to maintain consistency with the Alternative D13R simulation performed in support of the Restudy Recommended Plan.

Lands acquired by the District and the federal government as a result of the Talisman Land Exchange are available for use in implementation of the EAA Storage Reservoirs Project. The location and areal extent of those lands has been taken from Figure 2 of the January 2002 *EAA Storage Reservoirs Phase 1 Project, Project Management Plan*, which may be found on the CERP website, www.evergladesplan.org. As presented in that reference, the total land areas available as a result of the Talisman Land Exchange are as follows:

- Component A: 31,430 acres
- Component B: 9,302 acres
- Component C: 8,884 acres

The total lands available, as shown on Figure 2 of the PMP, aggregate to 49,616 acres. The EAA Storage Reservoirs Phase 1 Project Delivery Team will evaluate alternatives during the Project Implementation Report (PIR) phase. Depending on the results of this evaluation, the Phase 1 project may or may not incorporate the entire 49,616 acres.

For this Integrated Alternative, it was considered desirable to adjust the 49,616 available acres to reflect the probable loss of effective storage area to perimeter works such as levees and exterior borrow/seepage collection canals. A summary of the adjustments made for this analysis is presented in Table 6.1.

Table 6.1 Effective Surface Areas of EAA Reservoir Components on the Talisman Land

Compart.	Gross Area (ac)	Perimeter	Length (miles	Remarks	Edge Loss (ft)	Edge Loss (ac)	Net Area (ac)
A	31,430	West	6.0	External Borrow	360	262	
		North	11.7	External Borrow	360	511	
		East	8.0	Along NNR Canal; combine interior borrow and berm reconstruction	100	97	
		South	16.0	Along STA-3/4 Supply & Inflow Canal; combine interior borrow and berm reconstruction	100	194	30,367
B	9,302	West	8.7	Along NNR Canal; combine interior borrow and berm reconstruction	100	105	
		North	4.7	External Borrow	360	205	
		East	2.7	External Borrow	360	118	
		East	6.0	Adjacent to STA-2; interior borrow, extend exist levee	0	0	
		Southeast	1.7	Along L-6; combine interior borrow and berm reconstruction	100	21	8,853
C	8,884	West	6.7	Along L-3; combine interior borrow and berm reconstruction	100	81	
		North	4.0	Adjacent to STA-5; interior borrow, extend exist levee	0	0	
		East	4.0	Adjacent to Rotenberger Tract; interior borrow	200	97	
		South	3.2	Adjacent to STA-6; interior borrow, extend exist levee	0	0	8,706

For this Integrated Alternative, the net effective surface area of the three components is taken as 47,930 acres, comprised of 30,370 acres in Component A; 8,850 acres in Component B; and 8,710 acres in Component C.

A summary of the total average annual inflows to this Integrated Alternative is presented in Table 6.2. The information presented therein simply totals the 2050wPROJ simulated “future” (e.g., with CERP) inflows for the individual components of the overall Phase 1 and Phase 2 EAA Storage Reservoirs project developed and discussed in Parts 3 through 5, respectively.

Table 6.2 Aggregate Average Annual Inflows to Integrated Alternative

Source	Average Annual Inflow by Hydrographic Unit, Future (With CERP)										
	Western Canals		Miami Canal		NNR Canal		Hillsboro Canal		Total		Mean
	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)	TP Conc (ppb)
Lake Okeechobee											
Regulatory Releases	0	0	175,012	14,381	215,684	18,951	0	0	390,696	33,332	69
BMP Makeup Water	0	0	46,814	3,847	30,502	2,680	7,235	661	84,551	7,188	69
STA Irrigation Water	0	0	680	56	0	0	122	11	802	67	68
S-6/S-2 Basin Runoff	0	0	0	0	0	0	186,623	22,284	186,623	22,284	97
S-7/S-2 Basin Runoff	0	0	0	0	194,025	22,800	0	0	194,025	22,800	95
S-8/S-3 Basin Runoff	0	0	178,671	21,909	0	0	0	0	178,671	21,909	99
S-236 Basin	0	0	11,075	1,858	0	0	0	0	11,075	1,858	136
SSDD Basin	0	0	4,851	598	0	0	0	0	4,851	598	100
Eastern 298	0	0	0	0	0	0	14,409	3,661	14,409	3,661	206
C-139 Basin	149,704	33,070	11,203	1,939	0	0	0	0	160,907	35,009	176
C-139 Annex	11,944	1,180	0	0	0	0	0	0	11,944	1,180	80
All Sources	**161,648**	**34,250**	**428,306**	**44,588**	**440,211**	**44,431**	**208,389**	**26,617**	**1,238,554**	**149,886**	98
FW Mean Conc. (ppb)		**172**		**84**		**82**		**104**		**98**	

On average, approximately 13% of the inflow volume and 23% of the TP load is delivered in the Western Canals (L-2, Deer Fence, S&M, and L-3, considered to include the C-139 Annex). The Miami Canal is expected to deliver 35% of the average inflow volume and 30% of the TP load to the integrated project. The North New River Canal is expected to deliver 36% of the inflow volume and 30% of the TP load, with the remainder (16% of the volume and 17% of the TP load) arriving in the Hillsboro Canal.

A basic premise of this Integrated Alternative is that the hydrologic function of the EAA Storage Reservoir Project as simulated in 2050wPROJ for the Basin Specific Feasibility Studies not be compromised in the interest of water quality improvement. For this Integrated Alternative, the performance measure selected to address that premise is the extent to which water supply demands on the various reservoir components can be met. Table 6.3 presents a summary of the average annual environmental and Everglades Agricultural Area (EAA) water supply demands reflected in the 2050wPROJ simulation for the future (with CERP) condition. Those simulated demands are treated in this Integrated Alternative as fixed demands that must be met (on a daily basis over the 31-year simulation period) in the operation of the Integrated Alternative.

Table 6.3 Fixed Water Supply Demands

Description	Ave. Annual Demand in Acre-Feet				
	Comp. A1	Comp. A2	Comp. B	Comp. C	Total
Environmental Water Supply					
Surface	0	77,965	140,420	42,243	260,628
Subsurface	0	4,226	5,516	3,086	12,828
EAA Water Supply					
Miami Canal Basin	68,632	2,179	0	0	70,811
North New River Canal Basin	77,883	2,800	0	0	80,683
Total "Fixed" Demands	**146,515**	**87,170**	**145,936**	**45,329**	**424,950**

6.1.1. Baseline Discharges

Baseline discharges against which the performance of the Integrated Alternative will be measured consist of a summation of the baseline discharges from STA-2, STA-3/4, and STA-5 and 6 as defined in Parts 3, 4, and 5, respectively. The baseline discharges are summarized in Table 6.4.

Table 6.4 Baseline Discharges for Integrated Alternative

STA Identification	Total Discharge (2007-2056)		
	Volume (ac-ft)	TP Load (kg)	TP Conc. (ppb)
STA-2 (refer to Table 3.9)	10,105,800	386,911	31
STA-3/4 (refer to Table 4.13)	29,689,800	1,198,224	33
STA-5 (refer to Table 5.19)	6,920,800	388,668	46
STA-6 (refer to Table 5.20)	2,701,600	100,944	30
Total Discharge for Period	**49,418,000**	**2,074,747**	
Ave. Annual Discharge for Period	**988,360**	**41,494.9**	**34**

6.2. General Configuration

A schematic of the general configuration of the Integrated Alternative is presented in Figure 6.1.

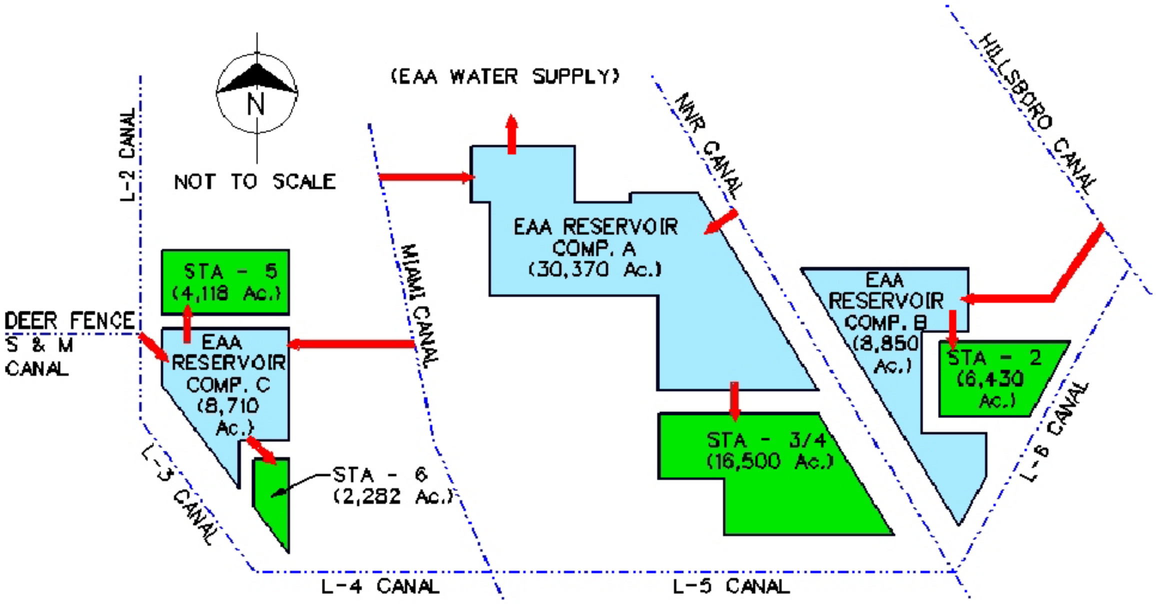


Figure 6.1 General Schematic, Integrated Alternative

As indicated in Figure 6.1, the total estimated net area of the available land of the EAA Storage Reservoirs is 47,930 acres. Note that the Phase 1 project may or may not use all 47,930 acres. The total effective treatment area of the four STAs to which those reservoirs would discharge is 27,091 acres. The flows presented in Table 6.2, 6.3, and 6.4 are the result of a full CERP simulation, i.e., all CERP components are in place including both Phase 1 and Phase 2 of the EAA Storage Reservoirs Project, and the ASR projects.

6.3. Reservoir Component C, STA-5 and STA-6

For this Integrated Alternative, it is assumed that all runoff from the C-139 Basin and the C-139 Annex are routed to Component C of the EAA Reservoirs Project in addition to the presently simulated inflows (regulatory releases) from Lake Okeechobee. Outflows from the reservoir would then be distributed to STA-5 and STA-6, in proportion to their estimated treatment capacity. STA-5 and STA-6 would be enhanced similar to Alternative 4 as it is described in Part 5. In addition, the proposed STA-6 control structure flexibility (as described in Part 5 Alt 4) is used to shift 6% of total inflows away from Cell 3 (mostly to Cells 2/4) in this Integrated Alternative due to resultant phosphorus concentrations slightly above geometric mean target (10 ppb). The average annual inflow volume over the 31-year period of the simulation is estimated to be 211,681 acre-feet, which includes an average annual inflow of 50,033 acre-feet of regulatory releases from Lake Okeechobee. The average annual inflow TP load to the reservoir is 38,361 kilograms, which includes an average annual inflow load of 4,111 kg in regulatory releases from Lake Okeechobee. The flow-weighted mean TP concentration in inflows to Component C is 147 ppb.

The physical configuration of the reservoir is modified from that discussed in Part 5, Alternative 4, to reflect the estimated net area of the reservoir available within the footprint of the lands obtained under the Talisman Land Exchange. The area of the reservoir is set at 8,710 acres, and the average land surface elevation is assumed equal to that in the SFWMM 2050wPROJ simulation (13.86 ft. NGVD). Daily rainfall and evapotranspiration estimates were taken from the data set for STA-6. Seepage losses from the reservoir (unrecovered) were assigned at 0.1 m/yr/m depth, consistent with the SFWMM 2050wPROJ simulation.

Total daily discharges from the reservoir were assigned at the <u>greater</u> of the following:

- Reservoir releases established at the daily values taken from the SFWMM 2050wPROJ simulation for environmental water supply.
- A stage-driven discharge rating, in which the desired total volume of release on any given day is established on the basis of the previous day stage in the reservoir. The discharge rating employed in this analysis is in the form:

$$Q=0.274*(D-1.5)^5, \text{ where}$$

Q= daily discharge volume in acre-feet
D= mean depth in the reservoir (e.g., stage minus mean ground surface elevation), in feet, on the previous day.

The analysis was initiated with an assigned stage of 15.36 ft. NGVD (1.5 ft. above the mean ground surface elevation). As indicated above, no discharge was assumed from the reservoir if the previous day’s stage was equal to or less than 15.36 ft. NGVD, <u>unless</u> the SFWMM

2050wPROJ simulation indicated the need for environmental water supply. The following stage and depth data resulted from the analysis:

Maximum stage = 22.95 ft. NGVD (mean depth of 9.09 ft., or 2.77m).
Average stage = 19.13 ft. NGVD (mean depth of 5.27 ft., or 1.61 m)
Minimum stage = 13.91 ft. NGVD (mean depth of 0.05 ft.)

The wet period fraction (e.g., proportion of time for which the water surface is above the mean ground surface elevation) for this analysis is 1.00.

It is noted that the above assumed operating "rule" for the reservoir is simplistic in nature; any number of operating rules could be postulated and tested. The purpose of this analysis was primarily to assess the impact of routing all 2050wPROJ simulated inflows to STA-5 and STA-6 through Compartment C on total phosphorus loads and concentrations entering the two treatment areas. Application of the above operating "rule" to Compartment C did permit all "fixed" daily water supply demands to be met.

6.3.1. TP Reduction in Component C of EAA Storage Reservoir

For this Integrated Alternative, it was necessary to estimate TP reductions in the EAA Storage Reservoir Component C in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir to STA-5 and STA-6. Those estimates were developed on the assumption that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoir was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. A summary of the long-term estimates of TP reduction in Component C of the EAA Storage Reservoir is presented in Table 6.5.

The estimated performance of the EAA Reservoir components in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 6.5 Estimated TP Reduction in Component C of the EAA Reservoirs

Mean Depth in Reservoir (m)	(For wet period fraction)				**1.604**
Approx. Basin Area (acres)					**8,710**
Approx. Basin Area (sq.m.)					**35,248,238**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)				
Input Parameters			**Estimated TP Removal**		
Average Inlet Concentration	mg/l	0.1467	q	7.312	
Average Annual Inflow Volume	ac-ft	211,681	K	0.060	
Average Annual Inflow Volume	cu.m.	261,105,717	P	153	ppb
Average Annual Rainfall	m	1.321	N	2.028	
Average Annual Evapotranspiration	m	1.366		3.019	
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.026	R	0.502	
Infiltration from Groundwater	m/yr	0.000	Pout	76	ppb
Water Balance Adjustment & Exfiltration	m/yr	0.1770	Pout	0.0763	mg/l
Change in Storage	m./yr.	0.051	REF:	*Phosphorus Removal by Urban Runoff Detention Basins;* Lake and Reservoir Management, Volume 3; North American Lake Management Society; 1987	
Ave. TP Conc. In Seepage Inflows	mg/l	0.000			
Wet Period Fraction		1.000			
SUMMARY OF RESULTS					
Reservoir Area	acres	8,710			
Ave. Annual Outflow Volume	cu.m.	251,493,523			
Ave. Annual Outflow Volume	ac-ft	203,888		Surface Discharges Only	
Mean TP Conc. In Outflows	mg/l	0.0763			

Discharges from Component C were considered as distributed to STA-5 and STA-6 in proportion to the available effective treatment area (4,118 acres in STA-5, 2,282 acres in STA-6). As a result, 64.3% of the daily discharges from Component C were assigned to STA-5, with the remainder assigned to STA-6.

6.3.2. TP Reduction in STA-5 and STA-6

For the Integrated Alternative, STA-5 and STA-6 were considered to be optimized or enhanced as described in Part 5 for Alternative 4 at each treatment area. Summaries of the estimated treatment performance of STA-5 and STA-6 for this alternative are presented in Tables 6.6 and 6.7, respectively, which consist of screen information taken directly from the DMSTA analyses.

6.4. Reservoir Component B, STA-2

For this Integrated Alternative, it is assumed that all STA-2 inflows are first routed to Component B of the EAA Reservoirs Project, and that there are no other inflows to that reservoir component. Outflows from the reservoir would then be delivered to STA-2, which would be optimized similar to that described for Alternative 2 in Part 3. The average annual inflow volume over the 31-year period of the simulation is estimated to be 208,267 acre-feet. The average annual inflow TP load to the reservoir is 23,060 kilograms. The flow-weighted mean TP concentration in inflows to Component B is 90 ppb.

The physical configuration of the reservoir is modified from that discussed in Part 4, Alternative 1, to reflect the estimated net area of the reservoir available within the footprint of the lands obtained under the Talisman Land Exchange. The area of the reservoir is set at 8,850 acres, and the average land surface elevation is assumed equal to that in the SFWMM 2050wPROJ simulation (10.60 ft. NGVD). Daily rainfall and evapotranspiration estimates were taken from the data set for STA-2. Seepage losses from the reservoir (unrecovered) were assigned at 0.1 m/yr/m depth, consistent with the SFWMM 2050wPROJ simulation.

Table 6.6 Results of DMSTA Analysis, Integrated Alternative, STA-5

Input Variable	Units	Value
Design Case Name	-	ALTInt1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename:** **5ALTInt1_Data.xls**

Cells 1A & 2A--Emergent & Cells 1B & 2B--SAV_C4
Integrated STAs
64.3% Comp C Flows to STA-5

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	12.7
Flow-Wtd Conc - Without Bypass	ppb	12.7
Geometric Mean Conc	ppb	7.4
95th Percentile Conc	ppb	16.4
Freq Cell Outflow > 10 ppb	%	28%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B		
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4		
Inflow Fraction	-	0.5	0	0.5	0		
Downstream Cell Number	-	2	0	4	0		
Surface Area	km2	3.379	4.937	3.379	4.937		
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	60	40	60		
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78		
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0033		
Outflow Seepage Control Elev	cm	-46	-38	-46	-38		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.90	13.39	20.45	27.84			27.84
Run Date	-	06/17/02	06/17/02	06/17/02	06/17/02			06/17/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1A	1B	2A	2B			Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow			-
Surface Area	km2	3.379	4.937	3.379	4.937			16.6
Mean Water Load	cm/d	6.6	4.4	6.6	4.4			2.7
Max Water Load	cm/d	74.8	50.9	74.8	50.9			30.4
Inflow Volume	hm3/yr	80.9	79.6	80.9	79.6			161.8
Inflow Load	kg/yr	6274.5	4200.6	6274.5	4166.6			12548.9
Inflow Conc	ppb	77.5	52.8	77.5	52.4			77.5
Treated Outflow Volume	hm3/yr	79.6	77.6	79.6	76.0			153.6
Treated Outflow Load	kg/yr	4200.6	985.3	4166.6	969.9			1955.3
Treated FWM Outflow Conc	ppb	52.8	12.7	52.4	12.8			12.7
Total FWM Outflow Conc	ppb	52.8	12.7	52.4	12.8			12.7
Surface Outflow Load Reduc	%	33.1%	76.5%	33.6%	76.7%			84.4%
Outflow Geometric Mean - Daily	ppb	52.0	7.6	51.8	7.8			7.6
Outflow Geo Mean - Composites	ppb	51.6	7.4	51.4	7.6			7.4
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	0%			28%

Table 6.7 Results of DMSTA Analysis, Integrated Alternative, STA-6

Input Variable	Units	Value	Case Description:	Filename: 6ALTInt1_650530_Data.xls
Design Case Name	-	ALTInt1	Cells 2,3 & 5a--Emergent and Cells 4 & 5b--SAV_C4	
Starting Date for Simulation	-	01/01/65	Integrated STAs	
Ending Date for Simulation	-	12/31/95	35.7% Comp C Flows to STA-6	
Starting Date for Output	-	01/01/65	65%/5%/30% internal flow split	

Input Variable	Units	Value	Output Variable	Units	Value
Steps Per Day	-	3			
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	-0.1%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	13.4
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	13.4
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	7.7
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	17.1
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	24%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	2	4	3	5a	5b	
Vegetation Type	------->	EMERG	SAV_C4	EMERG	EMERG	SAV_C4	
Inflow Fraction	-	0.65	0	0.05	0.3	0	
Downstream Cell Number	-	2	0	0	5	0	
Surface Area	km2	2.242	3.363	0.991	1.056	1.582	
Mean Width of Flow Path	km	2.34	2.32	0.61	1.12	1.48	
Number of Tanks in Series	-	3	3	3	3	3	
Outflow Control Depth	cm	40	60	40	40	60	
Outflow Coefficient - Exponent	-	1.67	1.67	3.08	3.56	5.07	
Outflow Coefficient - Intercept	-	0.18	0.2	0.63	0.29	0.24	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0.0059	0.0017	0	0	0	
Outflow Seepage Control Elev	cm	-46	-46	0	0	0	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0.5	0.5	0	0	0	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*15.66*	*80.10*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	7.42	14.03	20.42	27.42	34.52		34.52
Run Date	-	06/19/02	06/19/02	06/19/02	06/19/02	06/19/02		06/19/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95		12/31/95
Output Duration	days	11322	11322	11322	11322	11322		11322
Cell Label		2	4	3	5a	5b		Total Outflow
Downstream Cell Label		4	Outflow	Outflow	5b	Outflow		-
Surface Area	km2	2.242	3.363	0.991	1.056	1.582		9.2
Mean Water Load	cm/d	7.1	4.5	1.2	7.0	4.7		2.7
Max Water Load	cm/d	81.4	52.3	14.2	79.8	53.2		30.4
Inflow Volume	hm3/yr	58.4	55.9	4.5	27.0	26.9		89.9
Inflow Load	kg/yr	4528.7	2861.7	348.4	2090.2	1374.8		6967.3
Inflow Conc	ppb	77.5	51.2	77.5	77.5	51.1		77.5
Treated Outflow Volume	hm3/yr	55.9	54.6	4.4	26.9	26.8		85.9
Treated Outflow Load	kg/yr	2861.7	697.3	110.2	1374.8	342.3		1149.8
Treated FWM Outflow Conc	ppb	51.2	12.8	24.8	51.1	12.8		13.4
Total FWM Outflow Conc	ppb	51.2	12.8	24.8	51.1	12.8		13.4
Surface Outflow Load Reduc	%	36.8%	75.6%	68.4%	34.2%	75.1%		83.5%
Outflow Geometric Mean - Daily	ppb	50.6	7.9	21.4	48.8	6.8		8.9
Outflow Geo Mean - Composites	ppb	50.4	7.6	21.6	48.9	7.1		7.7
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	100%	0%		30%

Total daily discharges from the reservoir were assigned at the greater of the following:

- Reservoir releases established at the daily values taken from the SFWMM 2050wPROJ simulation for environmental water supply. For this analysis, all such releases are assigned to Component A, tributary to STA-3/4 (other than those previously assigned to Component C).
- A stage-driven discharge rating, in which the desired total volume of release on any given day is established on the basis of the previous day stage in the reservoir. The discharge rating employed in this analysis is in the form:

$$Q=19.50*(D-1.0)^{3.5}, \text{ where}$$

Q= daily discharge volume in acre-feet
D= mean depth in the reservoir (e.g., stage minus mean ground surface elevation), in feet, on the previous day.

The analysis was initiated with an assigned stage of 11.60 ft. NGVD (1.0 ft. above the mean ground surface elevation). As indicated above, no discharge was assumed from the reservoir if the previous day's stage was equal to or less than 11.60 ft. NGVD. The following stage and depth data resulted from the analysis:

Maximum stage = 16.89 ft. NGVD (mean depth of 6.29 ft., or 1.92m).
Average stage = 13.80 ft. NGVD (mean depth of 3.20 ft., or 0.98 m)
Minimum stage = 11.40 ft. NGVD (mean depth of 0.80 ft.)

The wet period fraction (e.g., proportion of time for which the water surface is above the mean ground surface elevation) for this analysis is 1.00.

It is noted that the above assumed operating "rule" for the reservoir is simplistic in nature; any number of operating rules could be postulated and tested. The purpose of this analysis was primarily to assess the impact of routing all 2050wPROJ simulated inflows to STA-2 through Compartment B on total phosphorus loads and concentrations entering the treatment area.

6.4.1. TP Reduction in Component B of EAA Storage Reservoir

For this analysis, it was necessary to estimate TP reductions in the EAA Storage Reservoir Component B in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir to STA-2. Those estimates were developed on the assumption that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoir was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. Summaries of the long-term estimates of TP reduction in Component B of the EAA Storage Reservoir are presented in Table 6.8.

The estimated performance of the EAA Reservoir components in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 6.8 Estimated TP Reduction in Component B of the EAA Reservoirs

Mean Depth in Reservoir (m)	(For wet period fraction)					**0.975**
Approx. Basin Area (acres)						**8,850**
Approx. Basin Area (sq.m.)						**35,814,800**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)					
Input Parameters			**Estimated TP Removal**			
Average Inlet Concentration	mg/l	0.1036	q	7.444		
Average Annual Inflow Volume	ac-ft	208,268	K	0.061		
Average Annual Inflow Volume	cu.m.	256,894,795	P	104	ppb	
Average Annual Rainfall	m	1.303	N	0.833		
Average Annual Evapotranspiration	m	1.009		2.081		
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.0253	R	0.351		
Infiltration from Groundwater	m/yr	0.000	Pout	68	ppb	
Water Balance Adjustment & Exfiltration	m/yr	0.536	Pout	0.0677	mg/l	
Change in Storage	m./yr.	0.0226	REF:	*Phosphorus Removal by Urban Runoff*		
Ave. TP Conc. In Seepage Inflows	mg/l	0.000		*Detention Basins;* Lake and Reservoir		
Wet Period Fraction		1.000		Management, Volume 3; North American		
				Lake Management Society; 1987		
SUMMARY OF RESULTS						
Reservoir Area	acres	8,850				
Ave. Annual Outflow Volume	cu.m.	247,403,873				
Ave. Annual Outflow Volume	ac-ft	200,572		Surface Discharges Only		
Mean TP Conc. In Outflows	mg/l	0.0677				

6.4.2. TP Reduction in STA-2

For the Integrated Alternative, STA-2 was considered to be optimized or enhanced as described in Part 3 for Alternative 2. A summary of the estimated treatment performance of STA-2 for this alternative is presented in Table 6.9, which consists of screen information taken directly from the DMSTA analysis.

Table 6.9 Results of DMSTA Analysis, Integrated Alternative, STA-2

Input Variable	Units	Value
Design Case Name	-	ALTInt1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description:	Filename: 2ALTInt1_Data.xls
Cells 1A & 2A--Emergent & Cell 1B, 2B, 3A & 3B--SAV_C4	
Integrated STAs	40/60 Split
STA-2 Flows only to/from Comp B	

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	11.5
Flow-Wtd Conc - Without Bypass	ppb	11.5
Geometric Mean Conc	ppb	5.7
95th Percentile Conc	ppb	15.2
Freq Cell Outflow > 10 ppb	%	15%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	SAV_C4	SAV_C4
Inflow Fraction	-	0.28	0	0.36	0	0.36	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	2.912	4.368	3.676	5.514	3.676	5.514
Mean Width of Flow Path	km	1.58	1.58	3.10	1.65	2.00	2.00
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	40	60	60	60
Outflow Coefficient - Exponent	-	2.48	2.53	2.92	1.99	2.93	3.05
Outflow Coefficient - Intercept	-	0.48	0.62	0.39	1.28	0.48	0.64
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.008	0.008	0	0	0	0
Inflow Seepage Control Elev	cm	76	76	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.009	0	0.015	0	0.015	0.006
Outflow Seepage Control Elev	cm	-61	0	-61	0	-30	-30
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.78	0	0.78	0	0.78	0.79
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*80.10*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.06	2.03	3.00	3.97	4.90	5.90	5.90
Run Date	-	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	2.912	4.368	3.676	5.514	3.676	5.514	25.7
Mean Water Load	cm/d	6.5	4.3	6.6	4.2	6.6	4.2	2.6
Max Water Load	cm/d	55.2	36.3	56.2	37.2	56.2	37.1	22.4
Inflow Volume	hm3/yr	69.3	68.5	89.1	83.7	89.1	84.4	247.6
Inflow Load	kg/yr	4746.0	2959.7	6102.0	3570.4	6102.0	1543.0	16950.0
Inflow Conc	ppb	68.5	43.2	68.5	42.6	68.5	18.3	68.5
Treated Outflow Volume	hm3/yr	68.5	69.6	83.7	82.9	84.4	81.3	233.8
Treated Outflow Load	kg/yr	2959.7	806.0	3570.4	1033.8	1543.0	844.8	2684.6
Treated FWM Outflow Conc	ppb	43.2	11.6	42.6	12.5	18.3	10.4	11.5
Total FWM Outflow Conc	ppb	43.2	11.6	42.6	12.5	18.3	10.4	11.5
Surface Outflow Load Reduc	%	37.6%	72.8%	41.5%	71.0%	74.7%	45.2%	84.2%
Outflow Geometric Mean - Daily	ppb	42.3	6.2	41.1	6.4	11.2	5.2	5.7
Outflow Geo Mean - Composites	ppb	42.4	6.1	41.3	6.3	11.2	5.1	5.7
Frequency Outflow Conc > 10 ppb	%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	16%

6.5. Reservoir Component A, STA-3/4

All inflows to the Integrated Alternative not assigned to Components B or C of the EAA Storage Reservoirs project are assigned to Component A. Those inflows include:

- All regulatory releases from Lake Okeechobee, other than the 50,033 acre-feet per year average annual volume assigned to Component C.
- All runoff from the Miami Canal and North New River basins.
- All other inflows directed to the Miami and North New River canals.

The average annual inflows to Compartment A are then estimated to be:

- An average annual inflow of 818,484 acre-feet.
- An average annual inflow TP load of 84,908 kilograms.

The flow-weighted mean TP concentration in inflows to Component A are estimated to be 84 ppb. All discharges from Component A (other than irrigation supply to the S-7 and S-8 basins) would be directed to STA-3/4, which would be optimized similar to that described for Alternative 2 in Part 4.

The physical configuration of the reservoir is modified from that discussed in Part 4 to reflect the estimated net area of the reservoir available within the footprint of the lands obtained under the Talisman Land Exchange. The area of the reservoir is set at 30,370 acres, and the average land surface elevation is assumed equal to the average of Compartments A1 and A2 in the SFWMM 2050wPROJ simulation (11.74 ft. NGVD). Daily rainfall and evapotranspiration estimates were taken from the data set for STA-3/4. Seepage losses from the reservoir (unrecovered) were assigned at 0.1 m/yr/m depth, consistent with the SFWMM 2050wPROJ simulation. Total daily discharges from the reservoir were assigned at the greater of the following:

- Reservoir releases established at the daily values taken from the SFWMM 2050wPROJ simulation for environmental water supply, and for Miami Canal Basin and North New River Canal Basin irrigation. In this instance, those releases include all of the following:
  - Miami Canal and North New River Canal Basin irrigation water supplied from Compartment A1, as represented in the SFWMM 2050wPROJ simulation.
  - Miami Canal and North New River Canal Basin irrigation water supplied from Compartment A2, as represented in the SFWMM 2050wPROJ simulation.
  - Environmental water supply to STA-3/4 from Compartment A2, including both surface and subsurface flows, as represented in the SFWMM 2050wPROJ simulation.
  - Environmental water supply to STA-3/4 from Compartment A2, including both surface and subsurface flows, as represented in the SFWMM 2050wPROJ simulation.
- A stage-driven discharge rating, in which the desired total volume of release on any given day is established on the basis of the previous day stage in the reservoir. The discharge rating employed in this analysis is in the form:

$$Q=0.33*(D-4.0)^6, \text{ (max. = 12,774), where}$$

Q= daily discharge volume in acre-feet

D= mean depth in the reservoir (e.g., stage minus mean ground surface elevation), in feet, on the previous day.

The analysis was initiated with an assigned stage of 15.74 ft. NGVD (4.0 ft. above the mean ground surface elevation). As indicated above, no discharge was assumed from the reservoir if the previous day's stage was equal to or less than 15.74 ft. NGVD, unless the SFWMM 2050wPROJ simulation indicated the need for either environmental water supply or irrigation water supply. The maximum rate of discharge from the reservoir (12,774 acre-feet per day) was established equal to the maximum design rate of inflow to STA-3/4 reflected in its current design. In essence, for all reservoir stages above elevation 21.5 ft. NGVD, the daily discharge was set at 12,774 acre-feet. The following stage and depth data resulted from the analysis:

Maximum stage = 22.65 ft. NGVD (mean depth of 10.91 ft., or 3.33m).

Average stage = 18.33 ft. NGVD (mean depth of 6.59 ft., or 2.01 m)

Minimum stage = 11.75 ft. NGVD (mean depth of 0.01 ft.)

The wet period fraction (e.g., proportion of time for which the water surface is above the mean ground surface elevation) for this analysis is 1.00.

It is noted that the above assumed operating "rule" for the reservoir is simplistic in nature; any number of operating rules could be postulated and tested. The purpose of this analysis was primarily to assess the impact of routing all 2050wPROJ simulated inflows to STA-3/4 through Compartment A on total phosphorus loads and concentrations entering the treatment area. Application of the above operating "rule" to Compartment A did permit all "fixed" daily water supply demands to be met.

6.5.1. TP Reduction in Component A of EAA Storage Reservoir

For this analysis, it was necessary to estimate TP reductions in the EAA Storage Reservoir Component A in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir to STA-3/4. Those estimates were developed on the assumption that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoir was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. A summary of the long-term estimate of TP reduction in Component A of the EAA Storage Reservoir is presented in Table 6.10.

The estimated performance of the EAA Reservoir components in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 6.10 Estimated TP Reduction in Component A of the EAA Reservoirs

Mean Depth in Reservoir (m)	(For wet period fraction)				**2.01**
Approx. Basin Area (acres)					**30,370**
Approx. Basin Area (sq.m.)					**122,903,442**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)				
Input Parameters			**Estimated TP Removal**		
Average Inlet Concentration	mg/l	0.084	q	7.939	
Average Annual Inflow Volume	ac/ft	817,848	K	0.064	
Average Annual Inflow Volume	cu.m.	1,008,806,119	P	91	ppb
Average Annual Rainfall	m	1.29	N	1.456	
Average Annual Evapotranspiration	m	1.48		2.612	
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.026	R	0.446	
Infiltration from Groundwater	m/yr	0.00	Pout	50	ppb
Seepage Out	m/yr	0.16	Pout	0.0501	mg/l
Change in Storage	m./yr.	0.08	REF:	*Phosphorus Removal by Urban Runoff Detention Basins;* Lake and Reservoir Management, Volume 3; North American Lake Management Society; 1987	
Ave. TP Conc. In Seepage Inflows	mg/l	0.000			
Wet Period Fraction		1.000			
SUMMARY OF RESULTS					
Reservoir Area	acres	30,370			
Ave. Annual Outflow Volume	cu.m.	955,928,142			
Ave. Annual Outflow Volume	ac-ft	774,979		Surface Discharges Only	
Mean TP Conc. In Outflows	mg/l	0.0501			

6.5.2. TP Reduction in STA-3/4

For the Integrated Alternative, STA-3/4 was considered to be optimized or enhanced as described in Part 4 for Alternative 2. A summary of the estimated treatment performance of STA-3/4 for this alternative is presented in Table 6.11, which consists of screen information taken directly from the DMSTA analysis.

Table 6.11 Results of DMSTA Analysis, Integrated Alternative, STA-3/4

Case Description: Cells 1A, 2A & 3A--Emergent & Cells 1B, 2B & 3B--SAV_C4
Integrated STAs (Compartment A)

Filename: 34ALTInt1_Data.xls

Input Variable	Units	Value
Design Case Name	-	AltInt1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	12.6
Flow-Wtd Conc - Without Bypass	ppb	12.6
Geometric Mean Conc	ppb	8.4
95th Percentile Conc	ppb	16.5
Freq Cell Outflow > 10 ppb	%	26%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.48	0	0.28	0	0.24	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	12.298	14.115	10.287	11.712	8.713	9.822
Mean Width of Flow Path	km	3.42	4.50	2.89	4.02	4.88	4.88
Number of Tanks in Series	-	6	3	6	3	4	4
Outflow Control Depth	cm	60	60	60	60	60	60
Outflow Coefficient - Exponent	-	2.45	2.9	2.6	3	2.1	2.1
Outflow Coefficient - Intercept	-	0.68	0.77	0.85	1.05	0.52	0.52
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.0058	0.0029	0.0014	0	0.0038	0
Outflow Seepage Control Elev	cm	-56	-56	-67	0	-64	0
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.51	0.52	0.46	0	0.46	0
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	12.07	18.42	33.58	40.52	49.07	57.65	57.65
Run Date	-	06/28/02	06/28/02	06/28/02	06/28/02	06/28/02	06/28/02	06/28/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	12.298	14.115	10.287	11.712	8.713	9.822	66.9
Mean Water Load	cm/d	8.2	6.8	5.7	4.9	5.8	4.9	3.1
Max Water Load	cm/d	61.5	53.3	42.9	37.8	43.4	38.2	23.6
Inflow Volume	hm3/yr	369.5	351.2	215.5	209.8	184.7	175.1	769.7
Inflow Load	kg/yr	19210.4	12788.4	11206.1	6796.4	9605.2	5756.4	40021.6
Inflow Conc	ppb	52.0	36.4	52.0	32.4	52.0	32.9	52.0
Treated Outflow Volume	hm3/yr	351.2	340.2	209.8	207.6	175.1	173.2	720.9
Treated Outflow Load	kg/yr	12788.4	4765.2	6796.4	2372.8	5756.4	1949.5	9087.5
Treated FWM Outflow Conc	ppb	36.4	14.0	32.4	11.4	32.9	11.3	12.6
Total FWM Outflow Conc	ppb	36.4	14.0	32.4	11.4	32.9	11.3	12.6
Surface Outflow Load Reduc	%	33.4%	62.7%	39.4%	65.1%	40.1%	66.1%	77.3%
Outflow Geometric Mean - Daily	ppb	31.8	9.8	27.7	7.8	28.4	7.8	8.6
Outflow Geo Mean - Composites	ppb	31.6	9.6	27.6	7.6	28.2	7.5	8.4
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	0%	100%	0%	38%

6.6. Implementation Schedule

The Integrated Alternative would be scheduled for completion in 2014, concurrent with the presently scheduled completion of the overall EAA Reservoirs project (Phase 1 and Phase 2). Certain elements of the Integrated Alternative would be completed in advance of that date. The following is a listing of the anticipated dates for completion of individual elements of the Integrated Alternative.

- All physical works for STA-2, Alternative 2, as described in Part 3, would be complete by December 31, 2006.
- All physical works for STA-3/4, Alternative 2, as described in Part 4, would be complete by December 31, 2006.
- All physical works for STA-6, Alternative 4, as described in Part 5, would be complete by December 31, 2006 (includes completion of STA-6, Section 2, as presently structured in the Everglades Construction Project).
- The optimization or enhancement of STA-5 would be conducted in two distinct phases; upon completion, the works would be similar to that described in Part 5 for STA-5, Alternative 4.
  - Conversion of Cell 2B to Submerged Aquatic Vegetation, as well as the addition of gates and automation at the G-343 structures, would be complete by December 31, 2006.
  - Remaining works, including the new pumping stations for the L-2 and Deer Fence/S&M canals, would be complete in 2014.
- Construction of the EAA Reservoirs, Component A, would be complete in 2009, the presently scheduled date for completion of the EAA Reservoirs project, Phase 1.
- Construction of the EAA Reservoirs, Components B and C, would be complete in 2014.

6.7. Total Discharges from Integrated Alternative

A summary of the total average annual discharge volumes and TP loads from the Integrated Alternative for STA-2, STA-3/4, STA-5 and STA-6 combined following full implementation is presented in Table 6.12.

Table 6.12 Average Annual Discharges for Integrated Alternative, 2015-2056

STA Identification	Average Annual Discharge		
	Volume (ac-ft)	TP Load (kg)	TP Conc. (ppb)
STA-2 (refer to Table 6.9)	189,500	3,268.2*	14*
STA-3/4 (refer to Table 6.11)	584,400	10,097.2*	14*
STA-5 (refer to Table 6.6)	124,500	2,155.4*	14*
STA-6 (refer to Table 6.7)	69,600	1,201.3*	14*
Ave. Annual Discharge for Period	**968,000**	**16,722.1***	**14***

*Increased from computed value to reflect lower limit of calibration range.

Table 6.13 summarizes the estimated total discharges from the Integrated Alternative over the 50-year period 2007-2056, given that:

- For the period 2007-2014, total discharges will consist of discharges from:
  - STA-2, Alternative 1 configuration, existing condition inflows.
  - STA-3/4, Alternative 2 configuration, existing condition inflows.
  - STA-5, Alternate 2 configuration, existing condition inflows.
  - STA-6, Alternative 2 configuration, existing condition inflows.
- For the period 2015-2056, discharges would be as identified in Table 6.12.

Table 6.13 Integrated Alternative, Total 50-Year Discharges

Period		Disch. From	Refer. Table	Ave. Annual Discharge		Total Discharge for Period	
From	To			Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)
2007	2014	STA-2	3.11	222,600	4,568.1	1,780,800	36,545
		STA-3/4	4.21	621,200	10,980.1	4,969,600	87,841
		STA-5	5.33	125,500	3,031.8	1,004,000	24,254
		STA-6	5.34	35,100	746.3	280,800	5,970
		Subtotal	-	1,004,400	19,326.3	8,035,200	154,610
2015	2056	All	6.12	968,000	16,722.1*	40,656,000	702,328*
2007	**2056**	**All**	**N/A**	**973,800**	**17,138.8***	**48,691,200**	**856,938***
Flow-weighted mean TP concentration in discharges, ppb							**14***

*Increased from computed value to reflect lower limit of calibration range.

6.8. Capital Cost Estimates

Inasmuch as the Integrated Alternative contemplates substantial modification to the2050wPROJ simulation, it would be desirable to identify the impact of those modifications on the overall cost of the EAA Reservoirs Phase 1 and Phase 2 Projects. Conceptual cost estimates prepared in connection with the conduct of the Restudy are not entirely consistent with the overall configuration presented in the current Project Management Plan for the EAA Reservoirs, Phase 1 project, and in any event are not available in sufficient detail to permit evaluation of the cost impacts of this alternative. It is therefore necessary to limit discussion of the potential impact of the Integrated Alternative on the EAA Reservoirs Phase 1 and Phase 2 Projects to identification of the changed or modified physical works of the assumptions used in the 2050wPROJ simulation. These modifications may or may not be applicable to the EAA Storage Reservoirs Phase 1 Project, which has not yet been defined to any degree of detail.

6.8.1. EAA Reservoirs, Base Configuration

The EAA Reservoirs Phase 1 and Phase 2 Project as simulated in 2050wPROJ for the Basin-specific Feasibility Studies includes a total of four compartments, the operation of three of which were simulated to impact inflow volumes and TP loads to STA-3/4. Two of those three compartments (A1 and A2) were simulated as being situated north of STA-3/4, generally between the North New River (NNR) and Miami canals. The third compartment (Compartment B) was simulated to be east of the North New River Canal adjacent to STA-2. The fourth compartment (Compartment C) was simulated to be between STA-5 and STA-6, immediately west of the Rotenberger Tract.

Compartment A1 was simulated to receive runoff from the NNR and Miami canal basins. Outflows from Compartment A1 were simulated to consist primarily of irrigation supply to the NNR and Miami canal basins. In addition, overflows from Compartment A1 were simulated as being directed to Compartment A2.

Compartment A2 was simulated to receive, in addition to those overflows from A1, regulatory releases from Lake Okeechobee, intended for use in satisfying environmental water supply demands. Outflows from Compartment A2 were simulated as being directed primarily to STA-3/4, and consist of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface). In addition to those outflows, overflows from Compartment A2 were simulated as being directed to Compartment B.

Compartment B was simulated to receive, in addition to those overflows from A2, regulatory releases from Lake Okeechobee, also intended for use in satisfying environmental water supply demands. All outflows from Compartment B were simulated as being directed to STA-3/4, and consisting of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface).

Compartment C was simulated to receive regulatory releases from Lake Okeechobee, intended for use in satisfying environmental water supply demands. All outflows from

Compartment C were simulated to be directed to STA-6, and consist of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface).

A schematic of the peak daily discharges to and from Compartments A1, A2 and B of the EAA Reservoir project, as simulated in 2050wPROJ, is presented in Figure 6.2.

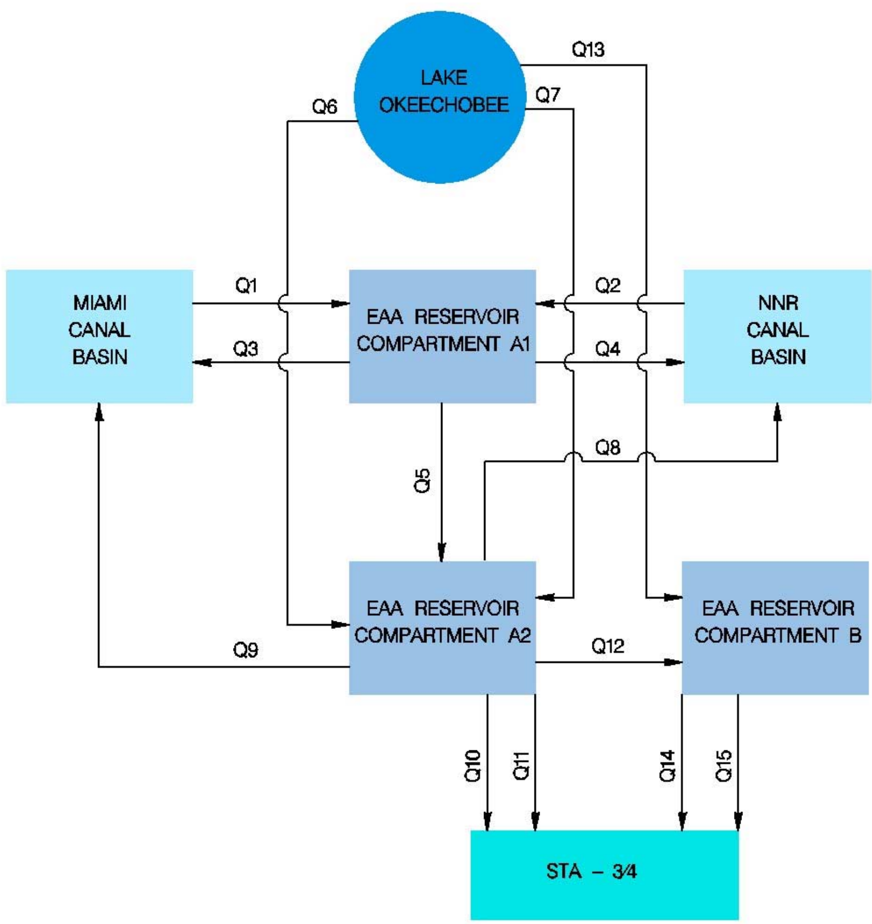


Figure 6.2 EAA Reservoirs Flow Schematic Vicinity STA-3/4

A listing of the maximum daily rates of discharge between the various reservoir compartments and STA-3/4 and STA-6 is presented in Table 6.14.

Table 6.14 Maximum Daily Discharges, EAA Reservoirs, 2050wPROJ Simulation

Flow Ident.	Description	Max. Daily Discharge (cfs)
Q1	Miami Canal Basin Runoff to Comp. A1	2,700
Q2	NNR Canal Basin Runoff to Comp. A1	2,300
Q3	Miami Canal Basin Irrigation from A1	1,157
Q4	NNR Canal Basin Irrigation from A1	1,481
Q5	Overflow, Compartment A1 to A2	1,168
Q6	Lake Regulatory Release to A2, Miami Canal	4,500
Q7	Lake Regulatory Release to A2, NNR Canal	3,000
Q8	NNR Canal Basin Irrigation from A2	1,376
Q9	Miami Canal Basin Irrigation from A2	942
Q10	STA-3/4 Inflow from A2, Surface	3,670
Q11	STA-3/4 Inflow from A2, Subsurface	750
Q12	Overflow, Compartment A2 to B	375
Q13	Lake Regulatory Release to B, NNR Canal	3,000
	Max. Daily Compartment B Inflows	3,375
Q14	STA-3/4 Inflow from B, Surface	3,670
Q15	STA-3/4 Inflow from B, Subsurface	750
	Lake Regulatory Release to C, Miami Canal	1,000
	STA-6 Inflow From C, Surface	1,000
	STA-6 Inflow From C, Subsurface	700

Inspection of the 2050wPROJ simulation future (with CERP) inflow data for STA-3/4 indicates that Pumping Stations G-370 and G-372 are utilized up to their nominal capacity for direct inflows to STA-3/4 (e.g., the capacity of those stations would not be considered as contributing to the above inflow rates to the EAA Reservoirs).

6.8.2. EAA Reservoirs, Integrated Alternative

The alternative EAA Reservoir project as formulated for the Integrated Alternative includes a total of three components, arranged and located generally as indicated in Figure 6.1.

Component A will receive all 2050wPROJ simulated inflows from the NNR and Miami canals, other than those Lake Okeechobee regulatory releases which were simulated as being delivered to Component C. Outflows from Compartment A will consist of irrigation supply to the NNR and Miami canal basins, and discharges to STA-3/4.

Compartment B will receive all 2050wPROJ simulated inflows to STA-2. All outflows from Compartment B will be directed to STA-2.

Compartment C will receive 2050wPROJ simulated regulatory releases from Lake Okeechobee, as well as all runoff from the C-139 Basin. All outflows from Compartment C will be directed to STA-5 and STA-6.

A listing of the maximum daily rates of discharge between the various reservoir compartments and stormwater treatment areas is presented in Table 6.15.

Table 6.15 Maximum Daily Discharges, EAA Reservoirs, Integrated Alternative

Flow Ident.	Description	Max. Daily Discharge (cfs)
Q1	Miami Canal Total Inflow to Component A	6,370
Q2	NNR Canal Total Inflow to Component A	4,470
Q3	Miami Canal Basin Irrigation from Component A	1,157
Q4	NNR Canal Basin Irrigation from Component A	1,481
Q10	STA-3/4 Inflow from Component A, Surface	6,440
	Max. Daily Compartment B Outflows to STA-2	3,343
	Lake Regulatory Release to C, Miami Canal	1,000
	C-139 Basin Inflow to Component C	2,096
	STA-6 Inflow From C, Surface	1,239
	STA-5 Inflow From C, Surface	2,233

For this Integrated Alternative configuration, Pumping Stations G-370 and G-372 are fully available for use as inflow pumping stations to Component A, with the result that the maximum daily inflows to Component A can be met with additional pumping station capacities of 2,700 cfs on the Miami Canal, and 2,300 cfs on the North New River Canal.

In addition, for this Integrated Alternative, there would be no anticipated need for a new inflow pumping station at Component B. The existing inflow pumping stations for STA-2 would fulfill that function (the maximum design stage in Component B was established to permit that function).

6.8.3. Summary of Adjustments to EAA Reservoir Phase 1 and Phase 2 Projects

As contemplated herein, the 2050wPROJ modeled configuration of the EAA Reservoirs Projects would be modified as follows in connection with the Integrated Alternative.

Compartments A1 and A2

Compartments A1 and A2 as modeled in 2050wPROJ have net areas of 20,000 and 21,500 acres respectively. In this Integrated Alternative, Al and A2 would be combined into a single compartment (Component A) occupying a gross area of 31,430 acres and providing a net reservoir area of approximately 30,370 acres. The usable storage depth would be increased from approximately 2.1 meters as modeled in 2050wPROJ to 3.3 meters. The following additional adjustments to 2050wPROJ would be included as well:

- The total length of levee forming the reservoir(s) would be reduced from roughly 53 miles to 42 miles. The height of the levees would be increased due to the greater usable storage depth (from approximately 15 feet above grade to approximately 20 feet above grade).
- Two inflow pumping stations associated with Compartment A1 would be deleted (2,700 cfs pumping station at the Miami Canal and 2,300 cfs pumping station at the North New River Canal, including new bridges on U.S. Highway 27).

- Two irrigation return structures associated with Compartment A1 would be deleted (1,200 cfs structure at the Miami Canal and 1,500 cfs structure at the North New River Canal).
- The overflow structure from Compartment A1 to Compartment A2 (1,200 cfs capacity) would be eliminated.
- The nominal capacity of two irrigation return structures associated with Compartment A2 would be increased. At the Miami Canal, the increase in capacity would be from 1,000 cfs to 1,200 cfs. At the North New River Canal, the increase in capacity would be from 1,400 cfs to 1,500 cfs.
- Inflow pumping stations originally associated with Compartment A2 would be reduced in nominal capacity to reflect the modified operation of Pumping Stations G-370 and G-372 as inflow stations to Component A (all STA-3/4 inflows would first pass through Component A). The newly installed pumping capacity from the Miami Canal would be reduced from 4,500 cfs to 2,700 cfs. The newly installed pumping capacity from the North New River Canal would be reduced from 3,000 cfs to 1,700 cfs.

<u>Compartment B</u>

This compartment (presently modeled in 2050wPROJ as providing a net surface area of 9,500 acres) would be replaced by Component B, providing a net surface area of approximately 8,850 acres on a gross land area of 9,302 acres. The usable storage depth would be reduced slightly from that modeled in 2050wPROJ in order to permit use of existing Pumping Station S-6 as the principal inflow pumping station to the reservoir component. No significant change in levee height would be anticipated. The following additional adjustments to 2050wPROJ would be included as well:

- It would be necessary to extend a new inflow canal, adjacent containment levee, and seepage canal along the north line of STA-2, connecting the existing STA-2 Supply Canal to Component B.
- New seepage return pumping stations would be needed to replace G-337A and G-337B.
- A 3,375 cfs inflow pumping station from the North New River Canal would be deleted.
- A 3,670 cfs capacity outflow control structure (originally intended to direct outflow to STA-3/4) would be relocated to direct inflows to STA-2 at the westerly end of the existing STA-2 Inflow Canal; the nominal capacity of the structure would be reduced to 3,350 cfs.

Compartment C

This compartment (presently modeled in 2050wPROJ as providing a net surface area of 9,000 acres) would be replaced by Component C, providing a net surface area of approximately 8,700 acres on a gross land area of 8,884 acres. The usable storage depth would be increased from approximately 2.1 meters as modeled in 2050wPROJ to 2.8 meters. The following additional adjustments would be included as well:

- The height of the levees would be increased due to the greater usable storage depth (from approximately 15 feet above grade to approximately 18 feet above grade).
- The nominal capacity of the outflow structure controlling discharges to STA-6 would be increased from 1,000 cfs to 1,240 cfs.

In this analysis, costs associated with the introduction of C-139 Basin runoff to the Western reservoir, and for discharges from the reservoir to STA-5, have been gathered with the estimated costs for STA enhancements. It should be noted that the need for the new inflow pumping stations would result strictly from the desire to direct C-139 Basin discharges to the reservoir. They would not otherwise be needed for STA-5.

6.8.4. Capital Cost for Integrated Alternative

Table 6.16 presents a summary opinion of the total capital cost of the Integrated Alternative presented herein. The total opinion of capital cost is comprised of the sum of the following:

- Estimated capital cost for STA-2, Alternative 1.
- Estimated capital cost for STA-3/4, Alternative 2.
- Estimated capital cost for STA-5, Alternative 4.
- Estimated capital cost for STA-6, Alternative 4.

Table 6.16 Opinion of Capital Cost, Integrated Alternative

Component Description	**Reference**	**Estimated Cost**
STA-2, Alternative 1	Table 3.15	$8,500,000
STA-3/4, Alternative 2	Table 4.17	$9,150,000
STA-5, Alternative 4	Table 5.63	$39,200,000
STA-6, Alternative 4 (same as Alternative 3)	Table 5.50	$2,330,000
Total, STA Enhancements		**$59,180,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

6.9. Incremental Operation and Maintenance Cost Estimates

Inasmuch as the Integrated Alternative contemplates substantial modification to the 2050wPROJ simulation, it would be desirable to identify the impact of those modifications on the overall cost of the EAA Reservoirs Phase 1 and Phase 2 projects. However, no estimate of the anticipated Operations and Maintenance Costs for the EAA Reservoirs Projects is available for such a comparison.

Table 6.17 presents a summary opinion of the average annual incremental operation and maintenance cost of the Integrated Alternative presented herein. The total opinion of capital cost is comprised of the sum of the following:

- Estimated incremental O&M cost for STA-2, Alternative 1.
- Estimated incremental O&M cost for STA-3/4, Alternative 2.
- Estimated incremental O&M cost for STA-5, Alternative 4.
- Estimated incremental O&M cost for STA-6, Alternative 4.

Table 6.17 Opinion of Incremental O&M Cost, Integrated Alternative

Component Description	**Reference**	**Estimated Cost**
STA-2, Alternative 2	Table 3.16	$260,000
STA-3/4, Alternative 2	Table 4.18	$310,000
STA-5, Alternative 4	Table 5.64	$905,000
STA-6, Alternative 4 (same as Alternative 3)	Table 5.52	$95,000
Total, STA Enhancements		**$1,570,000**

The opinions of probable operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

6.10. Opinion of Present Cost

The total present cost of capital improvements associated with the STA optimization and enhancement components of the Integrated Alternative is presented in Table 6.18, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation of 3%.

Table 6.18 Opinion of Present Capital Cost, Integrated Alternative, STA Components

Location	Expend.	Estimated Cost ($1,000s, 2002 $) by Year												Total
	Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Expend
STA-2	PED	$550												$550
	P&CM		$275	$275										$550
	Const.		$2,700	$2,700										$5,400
	Cont.		$1,000	$1,000										$2,000
	Lands													$0
STA-3/4	PED	$590												$590
	P&CM		$295	$295										$590
	Const.		$2,930	$2,930										$5,860
	Cont.		$1,055	$1,055										$2,110
	Lands													$0
STA-5	PED	$100									$2,400			$2,500
	P&CM		$50	$50								$1,200	$1,200	$2,500
	Const.		$550	$550								$11,750	$11,750	$24,600
	Cont.		$250	$250								$4,250	$4,250	$9,000
	Lands										$600			$600
STA-6	PED	$150												$150
	P&CM		$75	$75										$150
	Const.		$745	$745										$1,490
	Cont.		$270	$270										$540
	Lands													$0
All	Total	$1,390	$10,195	$10,195	$0	$0	$0	$0	$0	$0	$3,000	$17,200	$17,200	$57,790
Escalated Cost		$1,432	$10,816	$11,140	$0	$0	$0	$0	$0	$0	$4,032	$23,809	$24,523	$74,320
12/31/02 PC		$1,346	$9,558	$9,255	$0	$0	$0	$0	$0	$0	$2,173	$12,064	$11,682	$44,732

The total present cost of incremental operation and maintenance associated with the STA optimization and enhancement components of the Integrated Alternative is presented in Table 6.19, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation of 3%.

Table 6.19 Opinion of Present Cost, Incremental O&M, Integrated Alternative, STA Components

Year	Incremental O&M Cost by Location, in $1,000 2002 $					Escalated Cost	12/31/2002 Present Cost
	STA-2	STA-3/4	STA-5	STA-6	Total		
2007	$260	$310	$80	$95	$745	$864	$634
2008	$260	$310	$80	$95	$745	$890	$614
2009	$260	$310	$80	$95	$745	$916	$594
2010	$260	$310	$80	$95	$745	$944	$576
2011	$260	$310	$80	$95	$745	$972	$557
2012	$260	$310	$80	$95	$745	$1,001	$540
2013	$260	$310	$80	$95	$745	$1,031	$523
2014	$260	$310	$80	$95	$745	$1,062	$506
2015	$260	$310	$905	$95	$1,570	$2,306	$1,032
2016	$260	$310	$905	$95	$1,570	$2,375	$1,000
2017	$260	$310	$905	$95	$1,570	$2,446	$968
2018	$260	$310	$905	$95	$1,570	$2,519	$937
2019	$260	$310	$905	$95	$1,570	$2,595	$908
2020	$260	$310	$905	$95	$1,570	$2,673	$879
2021	$260	$310	$905	$95	$1,570	$2,753	$851
2022	$260	$310	$905	$95	$1,570	$2,836	$824
2023	$260	$310	$905	$95	$1,570	$2,921	$798
2024	$260	$310	$905	$95	$1,570	$3,008	$772
2025	$260	$310	$905	$95	$1,570	$3,099	$748
2026	$260	$310	$905	$95	$1,570	$3,191	$724
2027	$260	$310	$905	$95	$1,570	$3,287	$701
2028	$260	$310	$905	$95	$1,570	$3,386	$679
2029	$260	$310	$905	$95	$1,570	$3,487	$657
2030	$260	$310	$905	$95	$1,570	$3,592	$637
2031	$260	$310	$905	$95	$1,570	$3,700	$616
2032	$260	$310	$905	$95	$1,570	$3,811	$597
2033	$260	$310	$905	$95	$1,570	$3,925	$578
2034	$260	$310	$905	$95	$1,570	$4,043	$560
2035	$260	$310	$905	$95	$1,570	$4,164	$542
2036	$260	$310	$905	$95	$1,570	$4,289	$525
2037	$260	$310	$905	$95	$1,570	$4,418	$508
2038	$260	$310	$905	$95	$1,570	$4,550	$492
2039	$260	$310	$905	$95	$1,570	$4,687	$476
2040	$260	$310	$905	$95	$1,570	$4,827	$461
2041	$260	$310	$905	$95	$1,570	$4,972	$446
2042	$260	$310	$905	$95	$1,570	$5,121	$432
2043	$260	$310	$905	$95	$1,570	$5,275	$419
2044	$260	$310	$905	$95	$1,570	$5,433	$405
2045	$260	$310	$905	$95	$1,570	$5,596	$392
2046	$260	$310	$905	$95	$1,570	$5,764	$380
2047	$260	$310	$905	$95	$1,570	$5,937	$368
2048	$260	$310	$905	$95	$1,570	$6,115	$356
2049	$260	$310	$905	$95	$1,570	$6,299	$345
2050	$260	$310	$905	$95	$1,570	$6,488	$334
2051	$260	$310	$905	$95	$1,570	$6,682	$323
2052	$260	$310	$905	$95	$1,570	$6,883	$313
2053	$260	$310	$905	$95	$1,570	$7,089	$303
2054	$260	$310	$905	$95	$1,570	$7,302	$294
2055	$260	$310	$905	$95	$1,570	$7,521	$284
2056	$260	$310	$905	$95	$1,570	$7,747	$275
Total	**$13,000**	**$15,500**	**$38,650**	**$4,750**	**$71,900**	**$196,792**	**$28,684**

Table 6.20 summarizes the estimated total present worth of the Integrated Alternative.

Table 6.20 Summary Opinion of Present Cost, Integrated Alternative

Description	**Refer to Table**	**Present Cost (in $1,000)**
Present Worth of Capital Costs, STA Enhancements	6.18	$44,732
Present Worth of Incremental O&M, STA Enhancements	6.19	$28,684
Total, Present Worth of STA Enhancements		$73,416

6.11. Summary of Evaluation Criteria Scoring

Table 6.21 presents a summary of the evaluation criteria scoring for the Integrated Alternative. The information presented therein will subsequently be employed by the District and others in further evaluation of the alternative, and identification of that alternative or alternative(s) to be carried forward to the conceptual design phase.

Table 6.21 Summary Evaluation Criteria Scores, Integrated Alternative

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	2,075	Table 6.4
		50-Year TP Load Disc. - Alternative Int*	tonnes	857	Table 6.13*
		Phosphorus Load Reduction	%	58.7	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	14*	Table 6.12
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	-	
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	3	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$73,416,380	Table 6.20
	2	Total 50-Year TP Removal	kg	1,217,809	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$60.29	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

* Computed F.W.M. Conc. Less than LSC assigned as 14 ppb.

6.12. Sensitivity Analyses of Phosphorus Reduction Parameters

The effectiveness of phosphorus reduction in the alternatives considered are examined with respect to the change in the following three input parameters presented in the sensitivity analyses:

- Varying BMP Performance
- Different SAV Communities
- All Input Parameters
- Uncertainty Analysis

The third analysis (all input parameters) also employs an uncertainty analysis. The information presented therein will assist the District in further analyses of the alternatives presented in the future evaluation of the parameters.

6.12.1. Variation in BMP Performance

The current level of 50% TP load reduction in basin runoff due to BMPs in the EAA was varied to 25% and 75% TP load reduction to determine the effects the performance level of BMP on the phosphorus reduction parameters. The TP inflows into STA's were recalculated, including those involving the EAA Reservoir Projects. Table 6.28 summarizes, for the Integrated Alternative, the outcome of the phosphorus reduction performance due to varying BMP performance.

As with individual STA results presented in Parts 2 through 5, the results for the Integrated Alternative show that the phosphorus reduction performance is relatively insensitive to BMP performance.

Table 6.22 Variation in BMP Performance

Condition	Location	TP Conc. For BMP Load Reduction					
		25%		50%		75%	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
STA-2		Hills / WPB Canal Basin					
	Inflows	88	--	68	--	46	--
	Outflows	14*	10**	14*	10**	14*	10**
STA-3/4		Miami / NNR Canal Basin					
	Inflows	58	--	52	--	47	--
	Outflows	14*	10**	14*	10**	14*	10**
STA-5		USSC Basin#					
	Inflows	78	--	78	--	65	--
	Outflows	14*	10**	14*	10**	14*	10**
STA-6		USSC Basin#					
	Inflows	78	--	78	--	65	--
	Outflows	14*	10**	14*	10**	14*	10**

#also includes a 25% BMP Reduction of the C-139 Basin in the 75% BMP Case.
*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo. Mean Conc. Less than LSC assigned as 10 ppb.

6.12.2. Variation in SAV Performance

The current vegetative community (SAV_C4) within the four STA's was changed to the vegetative community (NEWS) to determine the effects of different vegetative communities on the phosphorus reduction parameters. In addition, all cells within the four STA's were converted to NEWS to determine the effects of STA's composed entirely of NEWS (ALLNEWS). Table 6.23 summarizes, for each of the four STA's, the outcome of the phosphorus reduction performance due to different SAV communities.

The results show that the phosphorus reduction performance is fairly sensitive to the SAV community used.

Table 6.23 Variation in SAV Performance

Condition	Location	TP Conc. For Different SAV Communities					
		SAV_C4		NEWS		ALLNEWS	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
STA-2							
	Inflows	68	--	68	--	68	--
	Outflows	14*	10**	19	10	18	10**
STA-3/4							
	Inflows	52	--	52	--	52	--
	Outflows	14*	10**	19	13	16	10
STA-5							
	Inflows	78	--	78	--	78	--
	Outflows	14*	10**	20	12	18	10**
STA-6							
	Inflows	78	--	78	--	78	--
	Outflows	14*	10**	20	12	18	10**

*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo. Mean Conc. Less than LSC assigned as 10 ppb.

6.12.3. All Input Variables (DMSTA Sensitivity Model)

The sensitivity of the phosphorus reduction performance to all input variables available in the DMSTA model was tested through its built-in Sensitivity Model which also includes an Uncertainty Analysis module. The Sensitivity Model assesses the average percent change in these four output parameters for each input changed:

- Treated Flow-weighted Mean Outflow Concentration
- Total Flow-weighted Mean Outflow Concentration
- Outflow Geometric Mean – Composite
- Total Outflow Load

A Sensitivity Scale Factor of 25% (i.e. 25% change in each input) was used in all runs. Both high and low results were tested; in other words, two runs were conducted for each input variable, one at 75% and the other at 125% of the original value of the input variable under consideration. With approximately 25 different input variables, multiplied by the number of cells in the STA, and the high and low end of results tested, the Sensitivity Analysis included a potential of 100 or more DMSTA runs for each case.

No change in output from any run for each case exceeded 25%. The biggest changes in the four output variables, consistently across each case, were caused by the following input variables:

- Inflow Fraction
- C0 = WC Conc at 0 g/m2 P Storage
- Surface Area
- "K" Settling Rate

The DMSTA Model also includes an Uncertainty Analysis that lists the actual change of any one of the four above-listed output variables based on the "uncertainty" of the input variables. If one of the 23 variables (available in this analysis) under consideration is insensitive, then the range of values will not change significantly.

The DMSTA Uncertainty Analysis uses results from the above Sensitivity Model. The input into the model is the variable labeled "Error CV", which is the Standard Error divided by the Mean. The default input Error CV in the DMSTA model was utilized for the analyses. The outputs are the 10^{th}, 50^{th}, and 90^{th} percentile estimate of the four listed output parameters.

Since the analysis of the Integrated Alternative includes no bypass analysis, the resultant Total Flow-weighted Mean Outflow Concentration is the same as the resultant Treated Flow-weighted Mean Outflow Concentration. Outputs from the four DMSTA cases are shown in Table 6.24:

Table 6.24 Uncertainty Analyses of All Input Variables

Condition	TP Conc. In DMSTA Sensitivity Analyses								
	10th Percentile Est.			50th Percentile Est.			90th Percentile Est.		
	F.W.	Geo.	Load	F.W.	Geo.	Load	F.W.	Geo.	Load
STA-2 Integrated Outflows	14*	10**	3,268*	14*	10**	3,268*	14	10**	3,303
STA-3/4 Integrated Outflows	14*	10**	10,097*	14*	10**	10,097*	15	10	11,157
STA-5 Integrated Outflows	14*	10**	2,155*	14*	10**	2,155*	15	10**	2,367
STA-6 Integrated Outflows	14*	10**	1,201*	14*	10**	1,201*	17	10	1,417

* Increased from computed value to reflect lower limit of calibration range.
**Computed Geo. Mean Conc. less than LSC assigned as 10 ppb.

The results show that in the uncertainty analyses, the geometric mean target of the phosphorus concentration for all STAs in the Integrated Alternative is met.